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Integrated Icing Diagnostic Algorithm (IIDA) Assessment Report

Danny Sims
Thomas Carty

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16. Abstract

This report describes the Assessment of the Integrated Icing Diagnostic Algorithm (IIDA) conducted by ACT-320 at the Aviation Weather Center (AWC) from March through May 1998.

The IIDA, developed by scientists at the National Center for Atmospheric Research (NCAR), combines a number of in-flight icing detection techniques into an integrated algorithm that makes use of the strengths of each technique. IIDA output is a graphical depiction of the potential for encountering in-flight icing.

The purpose of the assessment was to collect feedback from AWC forecasters on the utility of IIDA and to guide NCAR in making improvements to the algorithm.

Results of the assessment indicated there was value to integrating various icing detection techniques. The IIDA Icing Potential product appeared to provide the most benefit. In addition, several suggestions for IIDA enhancements were provided.

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EXECUTIVE SUMMARY

This report summarizes the Integrated Icing Diagnostic Algorithm (IIDA) Assessment conducted at the Aviation Weather Center (AWC) in Kansas City, Missouri, from March through May 1998. Specific results, conclusions, and recommendations for the assessment are detailed within this report.

The Research Applications Program at the National Center for Atmospheric Research (NCAR/RAP) has developed the IIDA by combining a number of icing detection techniques into an integrated algorithm that makes use of the strengths of each technique while simultaneously minimizing individual weaknesses. The IIDA makes use of satellite imagery, numerical weather prediction model output, radar reflectivity mosaic, and surface weather observations. The algorithm output consists of three-dimensional grids of Icing Potential and Supercooled Large Drop (SLD) Potential, augmented by several derived intermediate products to aid in assessing icing type and meteorological conditions associated with the icing.

The assessment was conducted by the Federal Aviation Administration (FAA) William J. Hughes Technical Center, Weather Branch (ACT-320). The assessment took place at AWC and involved collecting feedback from Area Forecasters responsible for issuing aviation weather advisories and warnings. The purpose of the assessment was to evaluate the current utility of the integrated algorithm and to guide NCAR/RAP in making improvements to the algorithm. In particular, the assessment collected feedback from AWC forecasters on their subjective perception of the value of the current IIDA as well as suggestions for improvements.

The results of the assessment indicated that there was value to integrating various icing detection techniques. In addition, the IIDA Icing Potential product appeared to provide the most benefit. AWC forecasters provided several suggestions for further enhancements to the IIDA. While the IIDA performed well when aircraft icing was the result of very organized, synoptic-scale weather systems, its performance was not significantly different than existing sources of icing information available to the AWC forecasters. However, it was noted that AWC is a relatively rich data environment, providing forecasters with a multitude of products to choose from in order to assist in the formation of aviation weather products.

The results of the assessment also indicated the IIDA SLD Potential product did not appear to perform well. The assessment results were not sufficient to provide reasons why the performance may have been poor. It is possible that SLD conditions did not exist in the atmosphere during the assessment period or the small areas of SLD Potential may not be represented within the format of the AWC issued advisories and warnings.

Recommendations from the assessment focus on further development of the IIDA including the development of a forecast capability that incorporates icing intensity.

1. INTRODUCTION.

1.1 BACKGROUND.

The Research Applications Program at the National Center for Atmospheric Research (NCAR/RAP) has conducted research and development activities for improvement of in-flight icing detection and forecasting since 1989. Efforts have focused upon applying algorithms to operational model output; using Geostationary Orbiting Environmental Satellite (GOES) data for detection of supercooled liquid at cloud top; combining surface observations and model outputs to diagnose supercooled large drop (SLD) conditions; and developing microphysical parameterizations for numerical weather models. To date, most of the icing diagnosis work has utilized single instruments or models. By themselves, these individual techniques are not adequate to diagnose icing conditions in every possible case. Each technique has its own strengths and weaknesses. A possible method of providing an improved icing diagnosis is to combine a number of techniques into an integrated algorithm that makes use of the strengths of each while simultaneously minimizing individual weaknesses. In recent years, NCAR/RAP has used "fuzzy logic" techniques for this sort of integration with considerable success. This approach lends itself well to icing problems, and is being pursued for the development of an integrated icing algorithm.

For the 1997-98 winter season, NCAR/RAP prepared an Integrated Icing Diagnostic Algorithm (IIDA) which makes use of GOES-8 satellite imagery, model output from the National Centers for Environmental Prediction (NCEP) Rapid Update Cycle (RUC), Next Generation Weather Radar (NEXRAD) reflectivity mosaic, and National Weather Service (NWS) surface observations. The algorithm output consisted of a three dimensional (3-D) grid of icing potential, scaled from 0 (no icing) to 100 (icing very likely). This was augmented by several derived intermediate products to aid in assessing icing type and the meteorological conditions associated with the icing. The IIDA currently does not have a forecast capability.

The initial assessment of the IIDA was conducted at the Aviation Weather Center (AWC) from March through May 1998. Personnel from the Federal Aviation Administration (FAA) William J. Hughes Technical Center (FAA Technical Center) Weather Branch (ACT-320) conducted the assessment in order to evaluate the current utility of the integrated algorithm and to guide NCAR/RAP in making improvements to the algorithm. In particular, the assessment collected feedback from AWC forecasters on their subjective perception of the value of the current IIDA as well as suggestions for improvements.

1.2 PURPOSE OF REPORT.

The purpose of this report is to document IIDA assessment activities, results, conclusions, and recommendations. This report will be provided to NCAR/RAP to assist with future development of the IIDA. Note that NCAR/RAP is conducting IIDA verification activities to measure the meteorological accuracy of the product. NCAR/RAP will be responsible for issuing a separate report on their verification work.

2. REFERENCE DOCUMENTS.

a. FAA-STD-024B; US Department of Transportation, Federal Aviation Administration Standard; Content and Format Requirements for the Preparation of Test and Evaluation Documentation.

b. Assessment Plan for the In-flight Icing Product Development Team Integrated Icing Diagnosis Algorithm (IIDA), FAA Technical Center and NCAR, February 27, 1998.

3. PRODUCT OVERVIEW.

The IIDA is an algorithm designed to integrate various data sources and provide a diagnosis of the potential for in-flight icing. Specific inputs, outputs, and hardware are described in the following sections.

3.1 IIDA COMPONENTS.

The IIDA uses the following data inputs:

a. GOES-8 multi-spectral satellite imagery;

b. RUC model output (Temperature, Relative Humidity, and Height);

c. NEXRAD reflectivity mosaic (NEXRAD Information Dissemination Service [NIDS] product);

d. NWS surface observations, including cloud coverage, ceiling height, and precipitation type.

The IIDA output consists of:

a. 3-D grids of Icing Potential, scaled from 0 (no icing) to 100 (icing very likely),
b. 3-D grids of SLD Potential, scaled from 0 (no SLD icing) to 100 (SLD icing very likely),
c. 3-D grids of Icing Type, scaled from 0 (rime) to 50 (mixed) to 100 (clear).

The IIDA data fields are scaled to match the standard RUC-2 data grid (40 kilometer (km) in the horizontal directions with 40 levels), with output produced on an hourly basis. Augmenting the primary output grids are several derived intermediate products in the form of two-dimensional (2-D) gridded data fields intended to aid in assessing in-flight icing. The intermediate 2-D products are:

a. Cloud Bases and Tops,
b. Icing Bases and Tops,
c. SLD Bases and Tops.

For the 1997-98-winter season, the IIDA products were exclusively a diagnosis of the real-time conditions; there was no forecast capability.

3.2 HARDWARE SYSTEM.

The IIDA software ran at NCAR/RAP on a Sun Ultra Sparc 1 workstation. Output grids and intermediate products were produced hourly and placed on the NCAR server. The AWC obtained the output via an automated file transfer process over the Internet. At AWC, the output and intermediate products were displayed on the Advanced Weather Interactive Processing System for National Centers (N-AWIPS), AWC's meteorological workstation. N-AWIPS consists of a Hewlett-Packard workstation with dual monitors for the display and animation of meteorological fields.

Forecasters viewed the IIDA in a four-panel N-AWIPS display. Three of the panels were color-filled contours of the three IIDA products at each level from 1000 millibars (mb) to 400 mb. The fourth panel showed Icing Pilot Reports (PIREP). Also available were single panel displays of 1000-400 mb Composite Maximum Icing and SLD Potential, Icing Bases and Tops, SLD Bases and Tops, and Cloud Bases and Tops.

4. ASSESSMENT DESCRIPTION.

4.1 ASSESSMENT SCHEDULE AND LOCATION.

Prior to the formal start of the assessment, NCAR personnel conducted training on February 11 and 12, 1998. The training included information on in-flight icing physics and IIDA background information. However, due to implementation problems, the IIDA was not available for hands-on training by AWC personnel. During the same time period as training, ACT-320 personnel conducted baseline observations and interviews with AWC area forecasters responsible for preparing Icing Airmen's Meteorological Statements (AIRMET) and Significant Meteorological Statements (SIGMET).

The actual IIDA Assessment was divided into two phases, both of which were conducted at AWC. The first phase was conducted on March 27 through April 10, 1998. This phase consisted of AWC area forecasters completing a daily questionnaire on the performance of the IIDA in regards to the preparation of Icing AIRMETs.

The second phase of the IIDA assessment consisted of ACT-320 personnel conducting observations and interviews with AWC area forecasters. These observations and interviews were conducted on April 27 and 28, 1998. Forecasters completing a second questionnaire, separate from the one described above that assessed the overall utility, reliability, and accuracy of the IIDA followed the observations and interviews. This questionnaire was administered from May 7 through 15, 1998.

4.2 PARTICIPANTS.

Fifteen AWC area forecasters participated in the first phase of the IIDA Assessment (i.e., the daily questionnaire) and 13 forecasters completed the questionnaire in the second phase. Of the 15 area forecasters participating in the assessment, ACT-320 personnel were able to observe and interview 10. The total number of AWC area forecasters operating at AWC during the assessment period was 17. Thus, the total number of participants was considered as a representative sample of the area forecaster population.

4.3 APPROACH.

The IIDA Assessment consisted of obtaining subjective feedback from AWC area forecasters. The forecasters reviewed the IIDA output and intermediate fields during normal operational shifts. ACT-320 personnel collected feedback on forecasters' impressions of the algorithm through the use of questionnaires, interviews, and operational observations. Results were determined from analyzing and summarizing the feedback.

4.3.1 Phase 1.

The first phase of the IIDA Assessment addressed the day-to-day performance of the IIDA and its utility in producing Icing AIRMETs and SIGMETs. Forecasters completed a daily questionnaire once per shift. The questionnaire was installed in an electronic format on a PC located in the forecaster work area at AWC. After completing the questionnaire, the forecaster's responses were automatically transferred to a Microsoft Access database on the PC. ACT-320 personnel performed a daily file transfer to access the most current version of the database.

4.3.2 Phase 2.

The second phase of the IIDA Assessment addressed the overall utility, reliability, and accuracy of the IIDA as perceived by AWC forecasters. ACT-320 personnel conducted observations and interviews, followed by forecaster completion of a questionnaire separate from the daily questionnaire used in phase 1. The observations and interviews were used to solicit information that may not have been ratable within the questionnaire format used in the first phase. The questionnaire addressed the overall utility, reliability, and accuracy of the IIDA. Forecasters completed the questionnaire once at the end of the assessment period. The End-of-Assessment Questionnaire was installed in an electronic format on the same PC located in the forecaster work area at AWC that was used for the daily questionnaire. The database was transferred to ACT-320 personnel at the end of the assessment period for data analysis.

4.4 ASSESSMENT OBJECTIVES.

The objectives of the IIDA assessment were:

a. Determine if there is value to integrating the various intermediate fields into a single output field;

b. Subjectively assess the value of the various intermediate products, specifically:

1. What components of the IIDA appear to be providing the most benefit for identifying areas of aircraft icing?

2. What components could be added to improve algorithm performance?

3. Under what situations does the IIDA perform well or not perform well?

c. Subjectively identify how the IIDA performance compares to current methods used by AWC forecasters for identifying the presence of aircraft icing conditions.

d. Identify AWC data inputs and platforms so that further development can be tailored to AWC operations.

4.5 ASSESSMENT DESCRIPTION AND METHODOLOGY.

4.5.1 Baseline Measures.

Concurrent with the preassessment training effort, baseline measures were obtained by ACT-320 personnel. The data inputs, platforms, and current procedures used by AWC area forecasters in determining icing AIRMETs and SIGMETs were identified. This information was collected in order to provide a comparison between current methodologies and IIDA. The information was obtained by ACT-320 personnel via forecaster interviews and observations of forecast operations.

4.5.2 Daily Questionnaire.

The purpose of the questionnaire was to rate each of the IIDA 3-D and 2-D components, and other products that AWC forecasters use to produce Icing AIRMETs and SIGMETs. Ratings were based on a 5-point Likert rating scale. In addition, each forecaster recorded a subjective measure of the Icing Potential and SLD Potential as compared to Icing PIREPs. Open-ended questions were also included soliciting suggestions for improvements, note-worthy performances, or other comments.

AWC forecasters were able to briefly note any negative or positive performance aspects of the algorithm during day-to-day use. Information from the daily questionnaire was used to identify specific instances of algorithm performance along with the date and time of the occurrence. A copy of the questionnaire is included in appendix A.

4.5.3 Interviews.

The IIDA Assessment included personal interviews of AWC area forecasters conducted by ACT-320 personnel. The intent of the interviews was to solicit information that was not ratable within the questionnaire format. Data from interview questions was used to provide insight into issues pertaining to the algorithm that were difficult or too time consuming for a user to write down. In addition, more detailed information, clarification on reported problems or benefits, and other pertinent comments were obtained during the interview process.

4.5.4 Observations.

Observations of AWC forecasters' use of IIDA during actual operations occurred in conjunction with the forecaster interviews discussed in section 4.5.3. ACT-320 personnel used observation logs to record how and under what circumstances the IIDA was used, whether other methods were used to produce icing AIRMETs and SIGMETs, and any additional feedback from the forecasters on duty. Observations were nonobtrusive to AWC operations.

4.5.5 End-of-Assessment Questionnaire.

In addition to the observations and interviews, AWC forecasters were provided the opportunity to complete a final questionnaire addressing the overall utility, reliability, and accuracy of the 3-D output fields of Icing Potential; SLD Potential; and Icing Type. Users also answered questions about the utility, reliability, and accuracy of the six 2-D IIDA intermediate product fields consisting of Cloud Bases and Tops, Icing Bases and Tops, and SLD Bases and Tops.

The questionnaire also included a number of open-ended questions soliciting suggestions for improving the algorithm, including suggestions for possible additional inputs and/or combinations of inputs. A copy of the questionnaire is included in appendix B.

4.5.6 Data Collection and Analysis.

Data collection was accomplished by administering the two separate questionnaires previously discussed, supplemented by on-site observations and interviews.

Product ratings from the daily questionnaire were analyzed using frequency distributions to determine which products (both of the IIDA and existing AWC capabilities) were rated most important in the preparation of Icing AIRMETs and SIGMETs. Since the number of daily questionnaires completed by each AWC forecaster varied, the median was used to determine an overall individual user response to each product rating. This was done to reduce the bias from users who completed the daily questionnaire several times during the assessment period. The individual user response median was used as a single data point in the frequency distribution for the product ratings.

The median score is the most appropriate measure of central tendency when using ordinal data (e.g., questionnaire ranking scales) as it relies on a ranking process. The median is the mid-point of the observations. When there is an even number of observations, no unique center value exists, so the mean of the two middle observations is taken as the median value.

The perceived accuracy of the Icing Potential and SLD Potential from the daily questionnaires was analyzed using frequency distributions to determine the range where the greatest concentration of moderate or greater icing PIREPs occurred. Each individual response was retained as a separate, independent, data point since weather conditions changed from day to day.

Ratings on product and component utility, reliability, and accuracy from the end-of-assessment questionnaire were analyzed using frequency distributions. Each user only completed the questionnaire once, thus there was no need to calculate and use the median in these frequency distributions. Each response was used as a single data point in the frequency distributions.

In addition, comments to interview questions were recorded and summarized. Recurring comments were tabulated.

5. RESULTS AND DISCUSSION.

This section presents the results of the IIDA Assessment. Section 5.1 discusses factors that may have affected the results. Section 5.2 discusses the results from the Daily Questionnaire. Section 5.3 discusses results from the Observations and Interviews. Section 5.4 discusses the results from the End-of-Assessment Questionnaire.

5.1 FACTORS AFFECTING RESULTS.

5.1.1 Training.

Due to delays in implementing the IIDA at AWC, NCAR personnel did not provide formal training on the algorithm itself. A seminar was presented on the science of in-flight icing and a description of IIDA. However, no formal training (either in a group setting or one-on-one) involved the actual IIDA. As a result, forecaster familiarity with the IIDA products and components appeared to be lacking in some instances. This may have influenced forecasters' use or non-use of the IIDA during the assessment period. Examples obtained from different phases of the assessment supported forecaster unfamiliarity. Specific examples included:

a. A forecaster stating during interviews they were not familiar with the algorithm;
b. A forecaster did not know Icing Type was available.
c. A forecaster requested that satellite imagery be incorporated within the IIDA.

5.1.2 Forecaster Preferences.

The AWC forecasters operate in a time-crucial environment, often without significant time available to review new products. In addition, the average AWC area forecaster has several years experience in producing AIRMETs and SIGMETs. Forecasters tend to use products that they have confidence in and seem reluctant to deviate from familiar products and procedures once confidence has been gained. Thus, any product introduced to AWC forecasters has to overcome inherent biases resulting from the time-crucial environment and the use of favored products. If new products and algorithms, such as the IIDA, are introduced without verification information demonstrating potential improvement over existing products, forecasters may be reluctant to use or even look at a product.

5.2 DAILY QUESTIONNAIRE RESULTS.

5.2.1 Product Rankings.

As described in section 4.5.2, forecasters evaluated each of the IIDA 3-D products and 2-D components as well as current products that AWC forecasters use to produce Icing AIRMETs and SIGMETs. Ratings were based on a 5-point Likert scale using the following ratings:

1 = The product or component was not used.
2 = The product or component had no value.
3 = The product or component had little value.
4 = The product or component had value.
5 = The product or component had the highest value.

Results of the forecasters' responses were tabulated and are shown in table 1. Products were ranked according to the median value of the responses and the number of users. As explained in section 4.5.6, the median of each user was used in the tabulation in order to reduce any bias due to some users providing responses on more occasions than other users. (Note that since the median of an individual user could be a multiple of 0.5, the median of an individual product could be a multiple of 0.25.) Products with equal median values were ranked according to the number of users who actually used the product. A product with an equivalent median value as another product would be ranked higher (lower) if a greater (lesser) number of users used the product.

The results in table 1 show that the highest ranked products (i.e., Graphical PIREPs, Textual PIREPs, Rawinsonde Observations [RAOB], and Satellite Images) are observations, rather than forecasts. This indicates the reliance that AWC forecasters place on observations of current conditions in producing their AIRMETs and SIGMETs. The highest ranking of any IIDA product or component was the Icing Potential, which ranked 11th out of 19 products.

TABLE 1. RANKINGS FOR PRODUCTS USED TO PRODUCE ICING AIRMETS AND SIGMETS

Product	Rank	Number of Users	Median Ranking
Graphical PIREPs	1	15	4.00
Text PIREPs	1	15	4.00
RAOB	1	15	4.00
Satellite	1	15	4.00
AIRMETs	5	13	4.00
NCAR/RAP Icing Algorithm	5	13	4.00
Neural Net Icing Product (NNICE)	7	12	4.00
Equivalent Potential Vorticity (EPV) Sounding	8	7	4.00
Constant Altitude Plan Position Indicator (CAPPI)	9	13	3.50
Model Temperature (T) and Relative Humidity (RH) Soundings	10	10	3.25
Radar	11	15	3.00
IIDA Icing Potential	11	15	3.00
IIDA Icing Bases & Tops	13	13	3.00
IIDA SLD Potential	14	12	3.00
IIDA Icing Type	15	11	3.00
Stovepipe	16	8	3.00
IIDA Cloud Bases and Tops	17	12	2.75
IIDA SLD Bases and Tops	18	11	2.50
Freezing Precipitation Observations (Precip. Obs.)	19	11	2.00

Product rankings according to forecaster shifts are shown in tables 2, 3, and 4. The Day Shift is from 7:00 am to 3:00 pm; the Evening Shift from 3:00 pm to 11:00 pm; and the Mid-Shift from 11:00 pm to 7:00 am (all times are Central Standard Time).

The results for the Day Shift (table 2) show the Icing Potential product rising to a ranking of 3 from 11 for all the shifts. The Evening Shift shows a slight increase from 11th to 9th; while the Mid-Shift showed an increase to 7th. The reason for the significant increase during the Day Shift is currently not understood.

TABLE 2. DAY SHIFT RANKINGS FOR PRODUCTS USED TO PRODUCE ICING AIRMETS AND SIGMETS

Product	Rank	Number of Users	Median Ranking
Satellite	1	9	5.00
EPV Sounding	2	2	4.50
IIDA Icing Potential	3	9	4.00
NCAR/RAP Icing Algorithm	4	8	4.00
RAOB	4	8	4.00
Text PIREPs	4	8	4.00
Graphical PIREPs	4	8	4.00
AIRMETs	8	7	4.00
CAPPI	8	7	4.00
NNICE	8	7	4.00
Model T & RH Soundings	11	4	3.50
Radar	12	9	3.00
IIDA Icing Bases & Tops	13	8	3.00
IIDA SLD Potential	14	7	3.00
IIDA Icing Type	14	7	3.00
IIDA Cloud Bases and Tops	16	6	2.50
IIDA SLD Bases and Tops	17	5	2.00
Stovepipe	18	1	2.00
Freezing Precip. Obs.	18	1	2.00

TABLE 3. EVENING SHIFT RANKINGS FOR PRODUCTS USED TO PRODUCE ICING AIRMETS AND SIGMETS.

Product	Rank	Number of Users	Median Ranking
Satellite	1	9	4.00
Graphical PIREPs	1	9	4.00
Text PIREPs	1	9	4.00
RAOB	1	9	4.00
AIRMETs	5	8	4.00
NNICE	5	8	4.00
IIDA Icing Bases & Tops	7	7	4.00
EPV Sounding	8	3	4.00
IIDA Icing Potential	9	9	3.50
NCAR/RAP Icing Algorithm	10	7	3.50
Radar	11	9	3.00
CAPPI	12	7	3.00
IIDA Cloud Bases and Tops	13	6	3.00
IIDA Icing Type	14	5	3.00
Model T&RH Soundings	14	5	3.00
Stovepipe	14	5	3.00
IIDA SLD Potential	17	7	2.50
IIDA SLD Bases and Tops	18	5	2.50
Freezing Precip. Obs.	19	5	2.00

TABLE 4. MID-SHIFT RANKINGS FOR PRODUCTS USED TO PRODUCE ICING AIRMETS AND SIGMETS

Product	Rank	Number of Users	Median Ranking
Satellite	1	10	4.00
Graphical PIREPs	2	9	4.00
Text PIREPs	2	9	4.00
NCAR/RAP Icing Algorithm	4	8	4.00
RAOB	4	8	4.00
NNICE	6	7	4.00
IIDA Icing Potential	7	10	3.00
Radar	7	10	3.00
IIDA Icing Bases & Tops	9	9	3.00
CAPPI	10	7	3.00
AIRMETs	11	6	3.00
IIDA Cloud Bases and Tops	11	6	3.00
Model T&RH Soundings	11	6	3.00
IIDA Icing Type	14	5	3.00
EPV Sounding	15	3	3.00
Stovepipe	15	3	3.00
IIDA SLD Potential	17	7	2.50
IIDA SLD Bases and Tops	18	6	2.25
Freezing Precip. Obs.	19	5	2.00

The results of IIDA compared against similar type products (i.e., model and or observation-based algorithms which diagnose or forecast the existence of icing) are shown in table 5. The highest-ranking product is the NCAR/RAP Icing Algorithm, which also has the greatest longevity in terms of availability for forecaster use of any of the products ranked. The other products also appear to be ranked according to the amount of time they have been in existence at AWC. The only exception to this is the Stovepipe algorithm. Comments during the assessment indicated that forecasters tend to not perceive surface observations of freezing precipitation (a major component of the Stovepipe algorithm) as a major factor in determining AIRMETs and SIGMETs. This will be discussed more in section 6.

TABLE 5. MODEL AND OBSERVATION-BASED ALGORITHM RANKINGS

Product	Rank	Number of Users	Median Ranking
NCAR/RAP	1	13	4.00
NNICE	2	12	4.00
IIDA Icing Potential	3	15	3.00
IIDA SLD Potential	4	12	3.00
Stovepipe	5	8	3.00

Within the IIDA itself, the results of the individual products and components are shown in table 6. The Icing Potential, with Icing Bases and Tops ranked the highest, followed by SLD Potential. Icing Type also recorded a median value of 3.0, but had fewer users than the other top-ranking products and components. The SLD Bases and Tops were ranked the lowest, possibly demonstrating less forecaster confidence in the vertical delineation of SLD conditions.

TABLE 6. IIDA PRODUCTS AND COMPONENTS RANKINGS

Product	Rank	Number of Users	Median Ranking
Icing Potential	1	15	3.00
Icing Bases and Tops	2	13	3.00
SLD Potential	3	12	3.00
Icing Type	4	11	3.00
Cloud Bases and Tops	5	12	2.75
SLD Bases and Tops	6	11	2.50

5.2.2 Icing and SLD Potential Range.

As stated in section 4.5.2, forecasters subjectively compared areas identified by the Icing Potential and SLD Potential products as having icing with regions having the greatest concentration of moderate or greater PIREPs. Table 7 presents the ratings that forecasters used in the comparison.

TABLE 7. PIREP COMPARISON RATING DEFINITIONS

Rating	Definition
1	No PIREPs were available
2	The product did not identify icing in regions where PIREPs were identified
3	Product values of 0-20 were where PIREPs were identified
4	Product values of 20-40 were where PIREPs were identified
5	Product values of 40-60 were where PIREPs were identified
6	Product values of 60-80 were where PIREPs were identified
7	Product values of 80-100 were where PIREPs were identified

The results of the Icing Potential comparison are shown in figure 1. Frequency distributions are used to identify where the greatest concentration of moderate or greater icing PIREPs occurred in comparison to the Icing Potential range. Figure 1a includes the cases when PIREPs were not available to the AWC area forecasters (value 1.0 on the horizontal axis in figure 1a). Many of these cases may have occurred during the late night when air traffic is at a minimum. Figure 1b removes the cases when PIREPs were not available and only shows the results when PIREPs were available. This latter result shows that 51 percent of the cases had the greatest concentration of moderate or greater PIREPs corresponding to Icing Potential ranges of greater than 60.

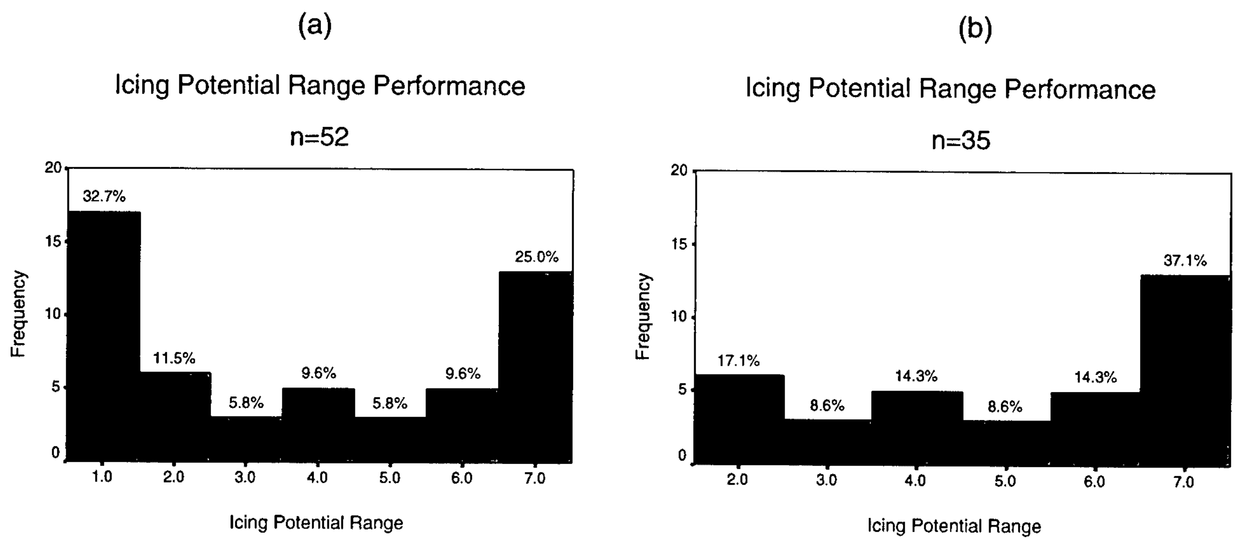


FIGURE 1. FREQUENCY DISTRIBUTION OF THE COMPARISON BETWEEN ICING POTENTIAL AND MODERATE OR GREATER PIREPS

Note: (a) all cases (number of responses, n = 52) and (b) cases with no PIREPs available removed (n = 35). Horizontal axis values are defined in table 7.

Results for the SLD Potential comparison with moderate or greater PIREPs are shown in figure 2. The range values are the same as given in table 7. Figure 2a includes the cases when PIREPs were not available. Figure 2b removes the cases when PIREPs were not available. The results demonstrate that 60 percent of the time, the SLD Potential did not identify the greatest concentration of moderate or greater PIREPs. However, it is not known whether this result is from the performance of the product or due to a lack of actual SLD conditions in the atmosphere during the assessment phase. Section 6 addresses this situation further.

(a) (b)

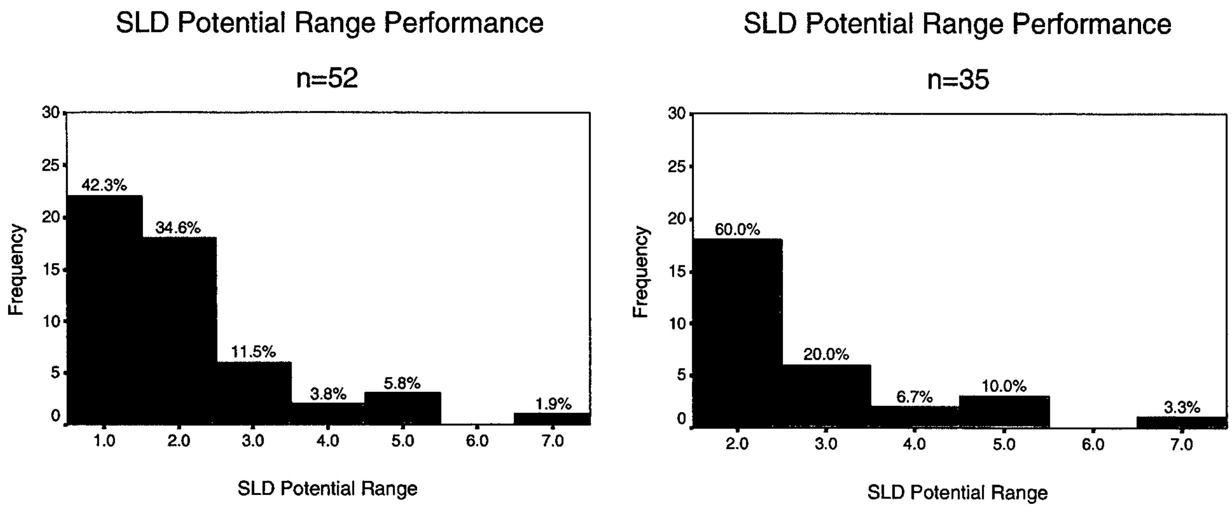


FIGURE 2. FREQUENCY DISTRIBUTION OF THE COMPARISON BETWEEN SLD POTENTIAL AND MODERATE OR GREATER PIREPS

Note: (a) all cases and (b) cases with no PIREPs available removed. Horizontal axis values are defined in table 7.

5.2.3 IIDA Added Value.

AWC area forecasters were asked to comment on whether the IIDA provided additional knowledge to icing situations that could not have been perceived from existing products. Out of a possible 52 responses, forecasters provided comments on 41 occasions (a 79-percent response rate). Overall responses were negative, with the majority indicating that the IIDA did not provide anything beyond what other diagnostics and algorithms provided. In addition, forecasters stated that on several occasions IIDA overforecasted (as do many other current techniques); on occasion did not identify isolated moderate reports of icing; and depicted the cloud tops too high. Other single responses included the icing tops were too low; IIDA depicted icing in cirrus clouds; and bases were too low.

The few positive responses indicated that on two occasions during the 2-week daily questionnaire period, IIDA identified low-level icing situations whereas other techniques did not. On two other occasions, the IIDA identified icing areas better than the NCAR/RAP algorithm.

Unedited forecaster comments on whether the IIDA provided additional knowledge to icing situations are listed in their entirety in appendix C.

5.3 OBSERVATIONS AND INTERVIEW RESULTS.

After the daily questionnaire phase had been completed, ACT-320 personnel observed and interviewed 10 of the 17 AWC area forecasters. Structured interview questions were used to allow forecasters to expand upon or clarify information obtained from the daily questionnaire. The interview questions and summarized responses are provided in the following sections. Complete forecaster responses to the structured interview questions are included in appendix D.

5.3.1 Question #1.

Did you use the IIDA for producing Icing AIRMETs/SIGMETs? Please explain why or why not.

Five respondents commented that they did not use IIDA very much. The reasons for not using IIDA included:

a. There was no forecast as part of IIDA;
b. Existing AWC products (such as PIREPs and surface observations) were sufficient;
c. A forecaster was not familiar with the algorithm;
d. New products are not used unless they immediately demonstrate superior results;
e. Availability problems;
f. A new area forecaster was becoming familiar with AWC systems;
g. One forecaster did not predominantly work forecast shifts during the assessment.

Five respondents commented that they did use the IIDA for producing Icing AIRMETs. Explanations included:

a. It was useful as a starting point in determining where current icing existed;
b. It was useful during midnight shifts when PIREPs were at a minimum.

It should be noted that forecasters who used the IIDA in producing Icing AIRMETs indicated that the IIDA output was very similar to existing AWC products and that a forecast component would have been more beneficial in producing an AIRMET.

No area forecasters reported that they used IIDA to produce Icing SIGMETs. SIGMETs tend to be driven by PIREPs of severe icing and forecasters rarely issue SIGMETs based only upon guidance information.

5.3.2 Question #2.

How did IIDA information compare to other icing information sources?

Overall, 7 out of 10 AWC area forecasters interviewed responded negatively. Many of the responses indicated that the IIDA was too similar to existing sources and did not provide any information that was not already available. Specific comments included:

a. IIDA was too similar to existing products with no new information presented;

b. IIDA did not reduce the area coverage of icing potential -- large areas were covered like other algorithms do;

c. IIDA improved only a little upon the NCAR/RAP algorithm;

d. A detection product does not help -- a forecast is needed;

e. Meso Eta output is preferred since the RUC (which is used in the IIDA) tends to not do as well in depicting moisture.

Three respondents compared IIDA favorably to other icing information sources. Comments included:

a. The IIDA is a good diagnostic tool with most of the icing appearing to occur in the Icing Potential range of 70 and higher;

b. IIDA appeared to reduce the coverage given by the Stovepipe algorithm;

c. The IIDA was not compared to other sources, however, the integration of information was useful and would be helpful during data sparse times. Normally, the forecaster must look at several profiles of icing information.

5.3.3 Question #3.

What components, if any, did you find most useful? Why?

Overall, AWC forecasters found the Icing Potential to be the most useful product, followed by Icing Bases and Tops, and Cloud Bases and Tops. Specific comments included:

a. Six respondents reported that Icing Potential was most useful since it appeared to be more accurate than other components (e.g., SLD Potential);

b. Four respondents reported that Icing Bases and Tops were useful;

c. Two respondents reported that Cloud Bases and Tops were useful since they appeared to be accurate.

Although the question asked for components that were useful, many respondents commented on components they found least useful, inadequate, or unreliable. These included:

a. Six respondents reported that SLD components (potential, tops, and bases) were not useful or needed;

b. Three respondents stated that Icing Type was not useful or very applicable;

c. One respondent stated IIDA was not useful because it lacked a forecast capability;

d. One respondent stated existing algorithms identify the potential for icing -- an algorithm for icing intensity is needed;

e. One respondent stated that Icing Tops was less useful than expected since icing and cloud tops were 4,000' - 6,000' too high;

f. One respondent stated that SLD bases and tops were not useful due to the lack of PIREPs to substantiate them.

5.3.4 Question #4.

Describe typical situations, if any, where the algorithm and/or its components performed well.

Overall, the IIDA appeared to perform best when icing was the result of organized, synoptic-scale weather systems. Specifically:

a. Four respondents reported that IIDA performed well with well defined or organized, synoptic situations. However, it was noted that other icing information sources also performed well under these situations;

b. One respondent reported that although IIDA performed well with organized synoptic situations, the icing situation was already known due to pattern recognition built by experience;

c. Six respondents did not identify any situations where the IIDA performed well.

5.3.5 Question #5

Describe typical situations, if any, where the algorithm and/or its components performed poorly.

Forecasters identified a variety of situations where the IIDA appeared to perform poorly. Several of these situations involved cloud levels. The SLD Potential product and components were also identified as performing poorly. Specific responses included:

a. IIDA did not always work well identifying low level icing (i.e., less than 10,000') -- the lower the icing the worse the performance;

b. IIDA would often identify icing when low-topped clouds existed 1,000 - 2,000' below the freezing level (i.e., in warm temperatures);

c. No icing was identified above 16,000' in the vicinity of the Rockies;

d. IIDA did not identify any icing with a very apparent icing producing synoptic system with layered clouds in the Pacific Northwest;

e. West area forecasters noted that terrain influences many icing situations -- IIDA, and in particular SLD Potential, did not seem to identify icing in the west region;

f. One respondent reported underdetection of icing at low levels in the northern Rockies;

g. One respondent reported that icing bases and tops appeared to have a low bias in the west;

h. One respondent reported that cloud tops appeared to be lower than their actual heights, while cloud bases appeared accurate.

Specific SLD-related responses included:

a. One respondent noted that the SLD Potential and Icing Type did not appear to be correlated;

b. One respondent reported that SLD Potential greatly reduced the identified icing areas by producing "islands" of icing, but the product does not appear to relate to anything;

c. One respondent reported that SLD areas were too small to meet AIRMET criteria.

5.3.6 Miscellaneous Responses.

Many of the AWC area forecasters offered comments in addition to the structured interview questions. Many of the comments concerned product improvements and are summarized as follows:

a. Seven of the ten respondents identified a forecast out to 12-18 hours as a necessary component;

b. Three respondents reported reliability issues as having a negative impact citing long down times, software glitches, and product update problems;

c. Two respondents recommended that vertical velocity fields be added;

d. Two respondents reported that IIDA display products needed smoothing to remove the blocky appearance;

e. Two respondents reported that testing should be done during the middle of the winter season in order to obtain a fair assessment;

f. One respondent recommended removing convective areas since convective-related icing is not an AIRMET criterion;

g. One respondent identified icing intensity as a necessary improvement;

h. One respondent suggested thresholding in order to decrease the identified areas;

i. One respondent reported that a better way of depicting multiple cloud layers is needed;

j. One respondent reported that the questionnaire needs to be located at the forecaster's work area.

5.4 END-OF-ASSESSMENT QUESTIONNAIRE.

Results for the End-of-Assessment Questionnaire are given in the following sections. As stated in section 4.5.5, products and components were rated in the areas of Utility, Reliability, and Accuracy. Results are shown for each IIDA product and component that was available to AWC area forecasters. Definitions used in the rating are in table 8, while the rating scale used for all three areas is in table 9. Note that in many cases a middle rating of "3 = Borderline" is construed as neutral, however, for the IIDA Assessment the rating is slightly positive due to the use of adequate in the definition.

TABLE 8. QUESTIONNAIRE RATING DEFINITIONS

Rating Area Definitions
Utility - The algorithm or component is useful, meets job requirements and responsibilities and aids in detecting and diagnosing areas of in-flight icing. An algorithm or component may be useful, but not accurate in detecting or diagnosing areas of in-flight icing.
Reliability – Algorithm/components are consistently working without problems. Data is provided consistently.
Accuracy - This refers to perceived accuracy of the algorithm or component. An algorithm or component may be perceived as accurate, but not useful in detecting or diagnosing areas of in-flight icing.

TABLE 9. QUESTIONNAIRE RATING SCALE DEFINITIONS

Rating Scale Definitions
1 = Largely Unacceptable - This response indicates the algorithm/component being assessed consistently impedes your ability to meet the requirements of your job; likely to lead to degradation of job performance.
2 = Barely Unacceptable - This response indicates the algorithm/component being assessed frequently impedes your ability to meet the requirements of your job; may lead to degradation of job performance.
3 = Borderline - This response indicates that, although the algorithm/component being assessed is adequate, minor improvements would make it more helpful.
4 = Barely Acceptable - This response indicates the algorithm/component being assessed frequently enhances your ability to meet the requirements of your job; may lead to enhanced job performance.
5 = Largely Acceptable - This response indicates the algorithm/component being assessed consistently enhances your ability to meet the requirements of your job; likely to lead to enhanced job performance.
NA - you have never used the algorithm/component in question.

5.4.1 Icing Potential.

Results for the Icing Potential product are shown in figure 3. Utility ratings, shown in figure 3a, indicate that the AWC forecasters perceived the product as useful with 75 percent of respondents giving a positive rating (i.e., 3 or higher). Reliability ratings, shown in figure 3b, indicate that 66 percent of the respondents gave the product a positive rating. However, 25 percent of the respondents rated the reliability as impeding their ability to meet the requirements of their job or degrading their job performance. It should be noted that IIDA was not provided from a 24-hour per day operation, thus, around-the-clock availability for the assessment was not to be expected. Accuracy ratings, shown in figure 3c, indicate that the majority of AWC forecasters (91 percent) perceived the Icing Potential as being accurate.

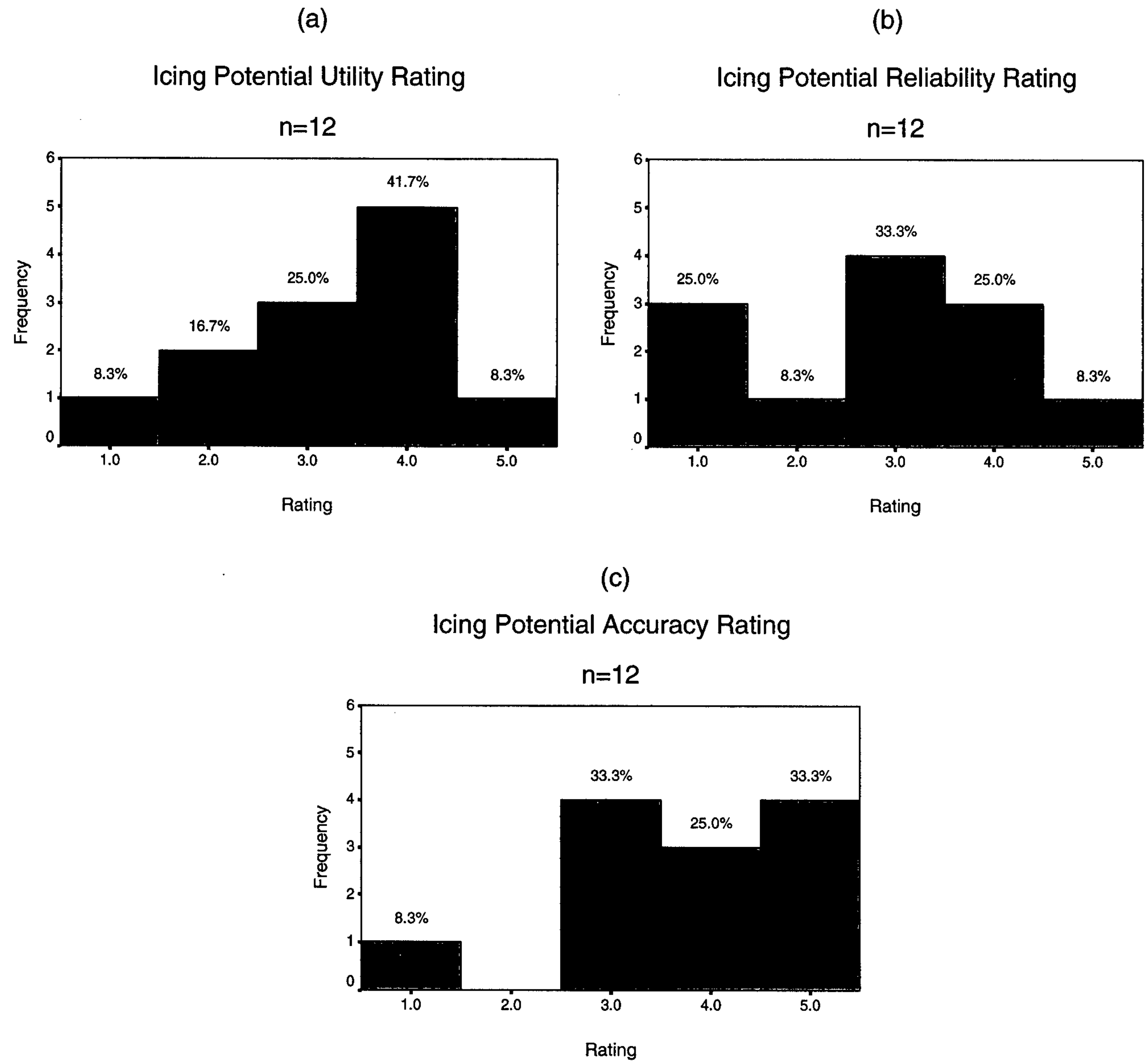


FIGURE 3. ICING POTENTIAL QUESTIONNAIRE RESULTS

Note: In each figure, the distribution of results is shown, the total number (n) of responses, and the percentage of responses for each rating scale.

5.4.2 SLD Potential.

Results for the SLD Potential product are shown in figure 4. In contrast to the mostly favorable ratings given to the Icing Potential, the preponderance of ratings for the SLD Potential were negative in each of the three rating areas. Utility ratings, shown in figure 4a, indicate a mixed reaction to the usefulness of the SLD Potential. However, the majority of the responses were 3 (i.e., borderline) or below, indicating that AWC forecasters believe improvements would be helpful. Reliability ratings, shown in figure 4b, indicate that the majority of forecasters believed the reliability to be borderline or below. Accuracy ratings, shown in figure 4c, indicate that over 66 percent of forecasters rated the accuracy of the SLD Potential product as unacceptable whereas the remaining 33 percent rated the product as "borderline." See figure 3 for a description of the figures.

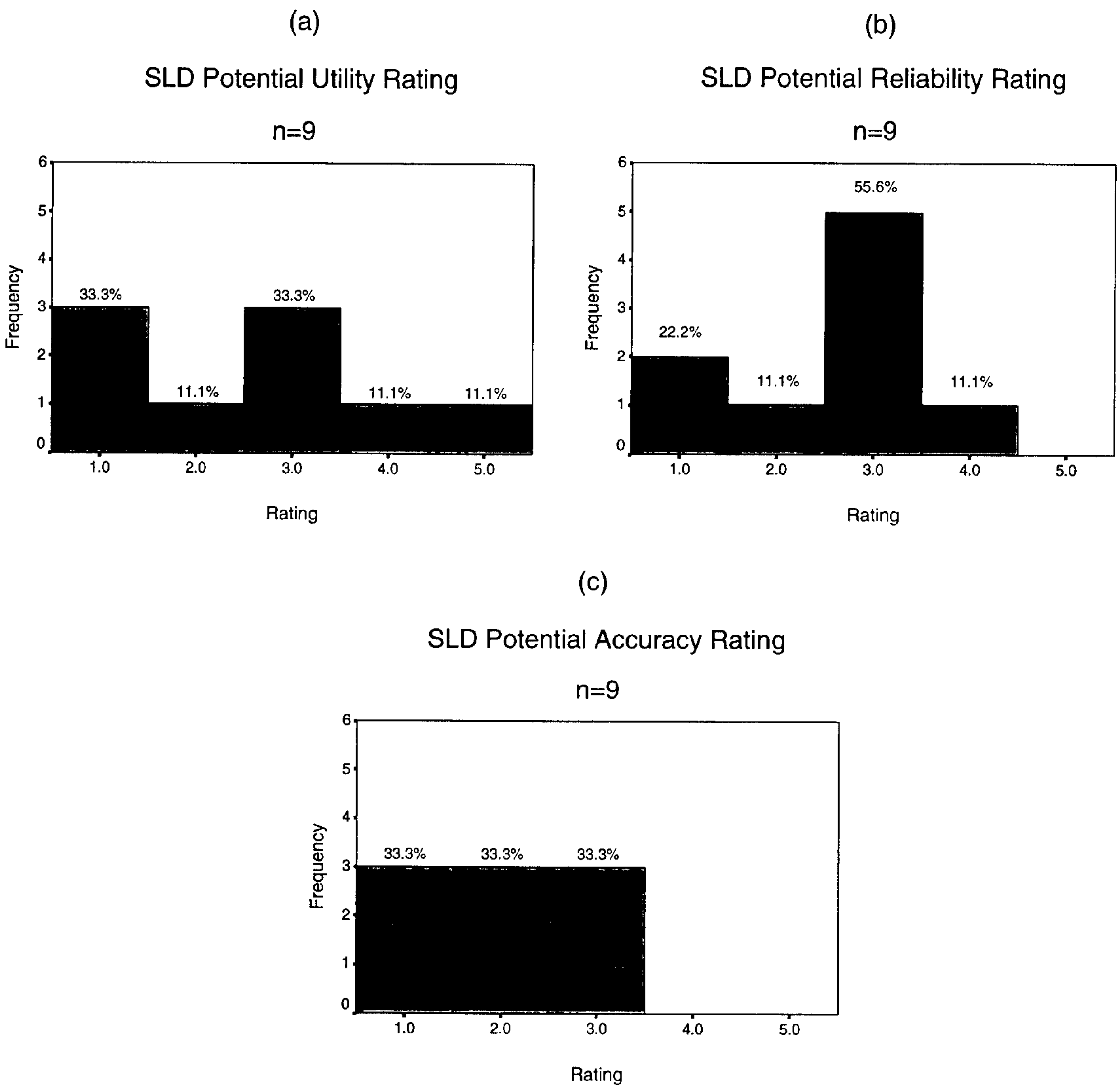


FIGURE 4. SLD POTENTIAL QUESTIONNAIRE RESULTS

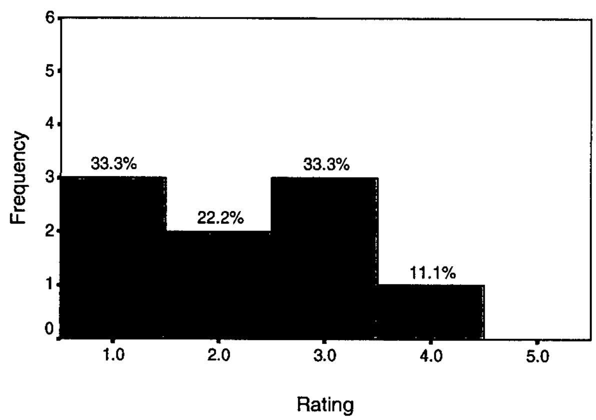
5.4.3 Icing Type.

Results for the Icing Type product are shown in figure 5. Overall, the Icing Type product received negative ratings in two of the three areas. Utility ratings, shown in figure 5a, indicate that the majority of the respondents (55 percent) felt the product impeded their ability to meet their job requirements (i.e., ratings of 1 and 2). Reliability ratings, shown in figure 5b, indicate that the majority of the AWC area forecasters rated the reliability as being adequate. Accuracy ratings, shown in figure 5c, indicate that 77 percent of respondents perceived the product as not accurate (i.e., ratings of 1 and 2). See figure 3 for a description of the figures.

(a)

Icing Type Utility Rating

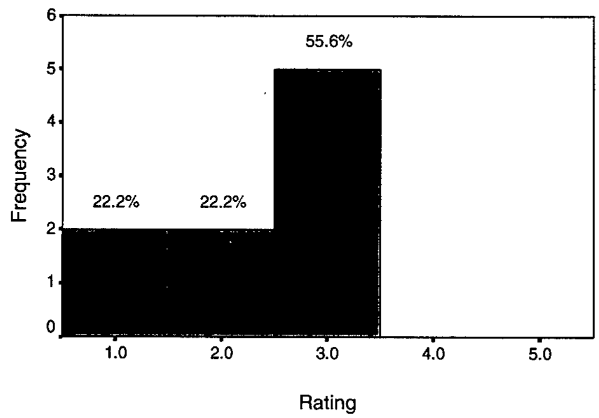
n=9



(b)

Icing Type Reliability Rating

n=9



(c)

Icing Type Accuracy Rating

n=9

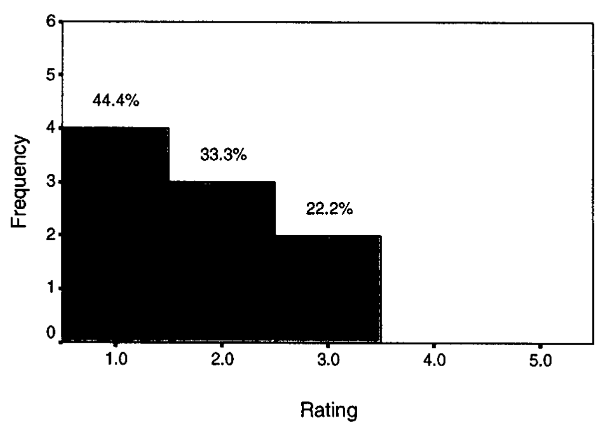


FIGURE 5. ICING TYPE QUESTIONNAIRE RESULTS

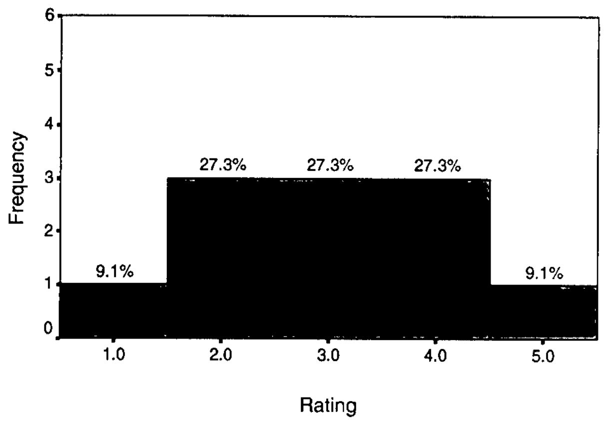
5.4.4 Icing Bases and Tops.

The Icing Bases and Tops were rated separately from each other. Results for the Icing Bases component are shown in figure 6. Utility ratings, shown in figure 6a, were equally distributed around the Borderline rating. Forecaster comments indicated that many rely on other sources to determine the icing base (most notably, freezing levels from observed soundings). Reliability ratings, shown in figure 6b, indicate a negative tendency in the ratings where only one forecaster rated Icing Base as clearly positive. Accuracy ratings, shown in figure 6c, also indicate an overall negative rating. For both reliability and accuracy, most ratings fell within the borderline range. See figure 3 for a description of the figures.

(a)

Icing Base Utility Rating

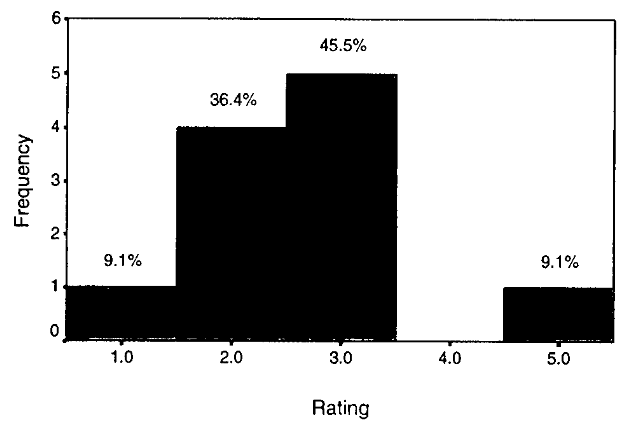
n=11



(b)

Icing Base Reliability Rating

n=11



(c)

Icing Base Accuracy Rating

n=11

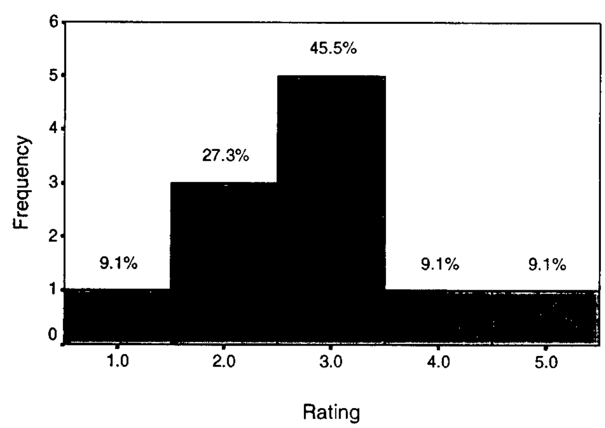


FIGURE 6. ICING BASES QUESTIONNAIRE RESULTS

In comparison to the Icing Bases, the utility of the Icing Tops, shown in figure 7a, exhibits an overall positive rating. The difference in ratings for Icing Bases and Tops may be due to forecasters' confidence in existing observation-based sources of icing bases (such as soundings with the freezing level). However, a direct observation of Icing Tops is not available, thus, forecasters do not have a similar product for tops information. This may account for the difference in the utility ratings. Reliability ratings, shown in figure 7b, demonstrate an adequate rating. Accuracy ratings, shown in figure 7c, indicate a slightly negative rating, where 67 percent of forecasters rated the Icing Tops borderline or below. See figure 3 for a description of the figures.

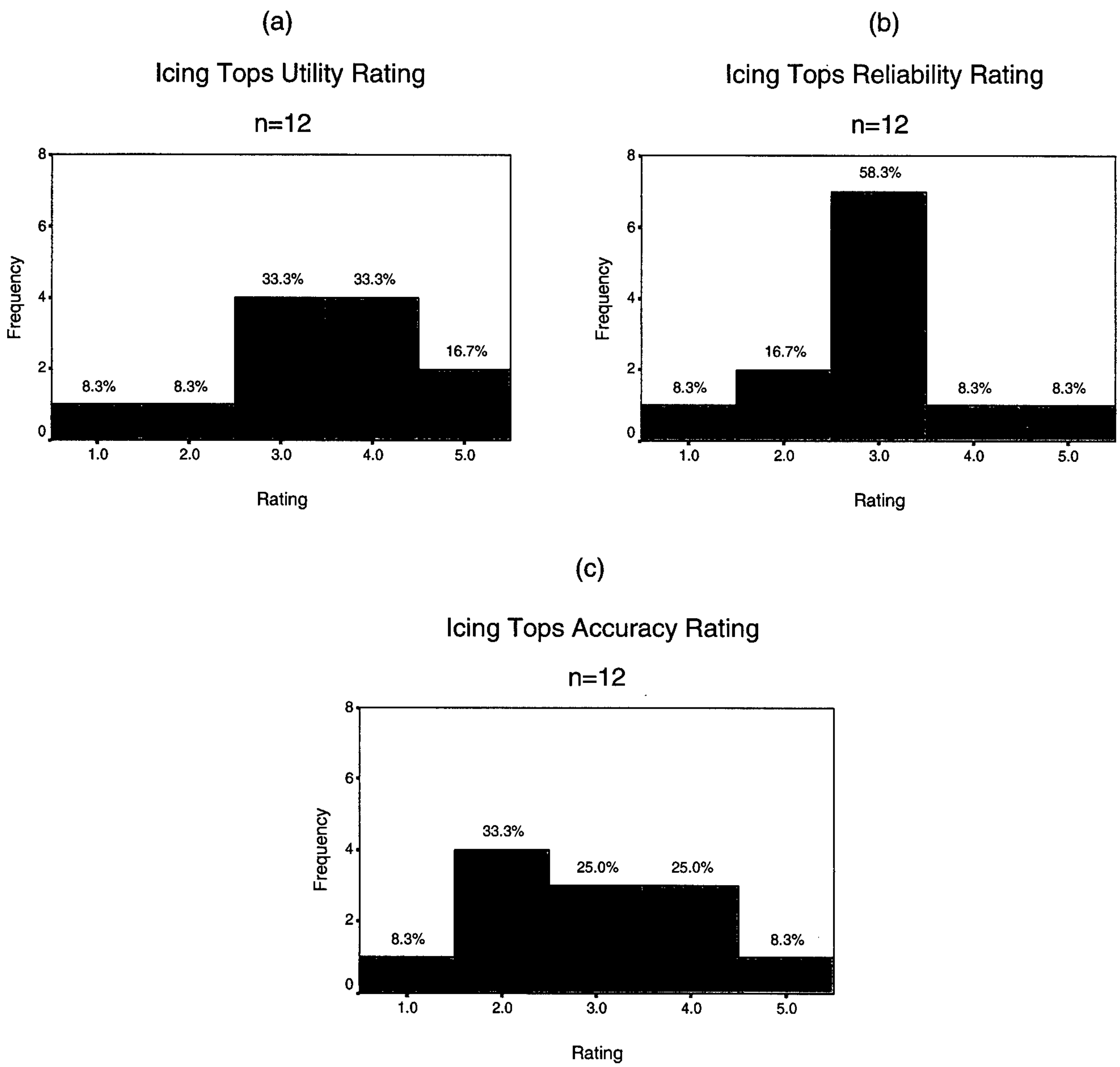


FIGURE 7. ICING TOPS QUESTIONNAIRE RESULTS

5.4.5 SLD Bases and Tops.

SLD Bases and Tops were rated separately from each other. The number of respondents for the SLD Bases and Tops was the lowest of the IIDA products and components. The low number of respondents may have been due to unfamiliarity (see section 5.1.1). Ratings for SLD Bases are shown in figure 8. Utility ratings, shown in figure 8a, indicate a bimodal response; either forecasters generally thought the product frequently enhanced their ability or it consistently impeded their ability. Reliability ratings, shown in figure 8b, indicate a negative tendency in the ratings where 50 percent of respondents rated the reliability as unacceptable and 37 percent as borderline. Accuracy ratings, shown in figure 8c, also indicate a predominantly negative rating, although two respondents (25 percent) found the accuracy acceptable. See figure 3 for a description of the figures.

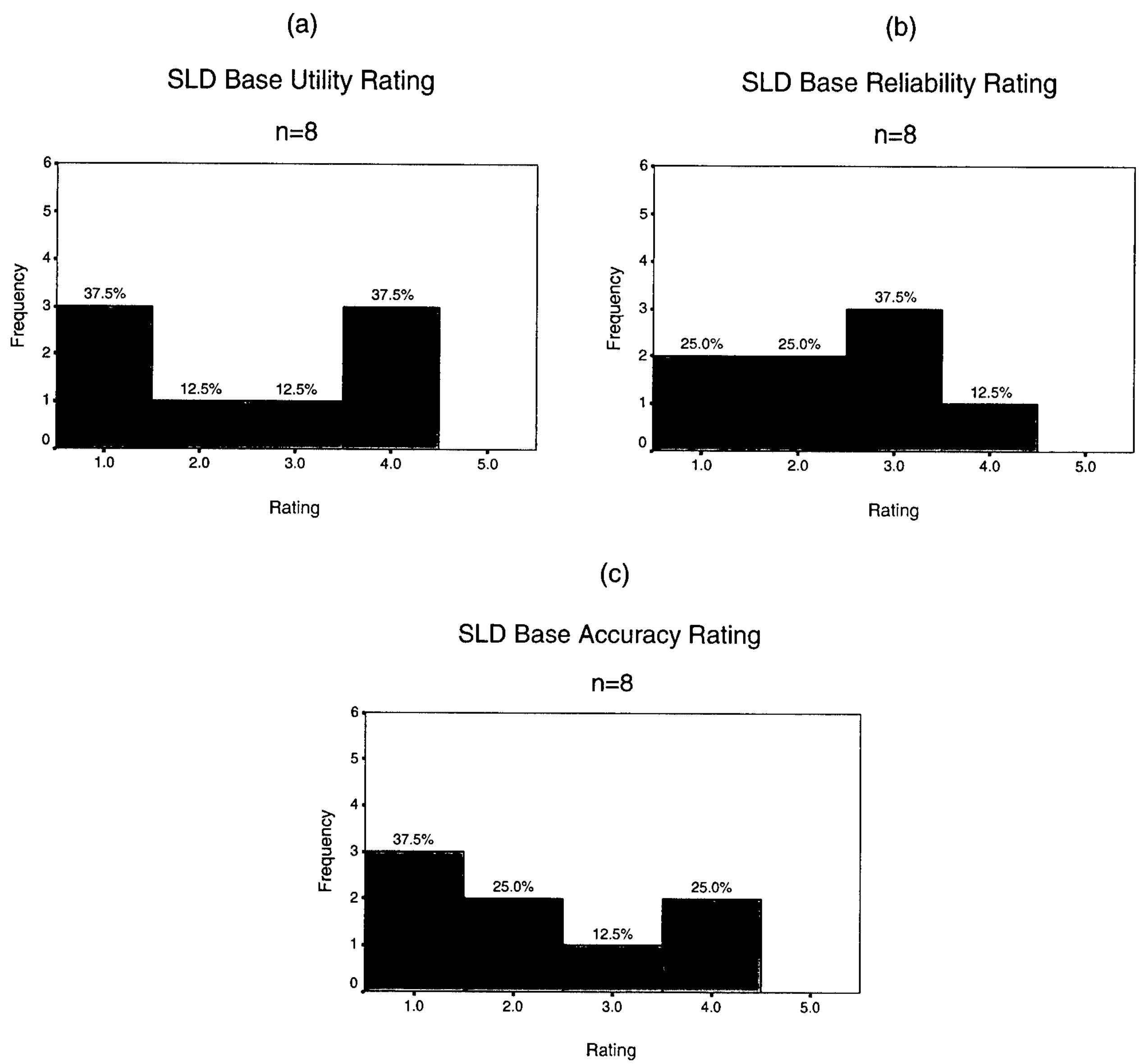


FIGURE 8. SLD BASES QUESTIONNAIRE RESULTS

Overall ratings for the SLD Tops, shown in figure 9, tended to be negative. Utility ratings for the SLD Tops, shown in figure 9a, do not exhibit the same bimodal distribution as the SLD Bases. Instead, the responses indicate an overall negative rating for the usefulness of the product, where over 57 percent rated utility negatively. Reliability ratings, shown in figure 9b, also indicate a general negative rating. Accuracy ratings, shown in figure 9c, indicate a significant negative tendency, with only one positive response. Again, note the small number of respondents for SLD Tops. See figure 3 for a description of the figures.

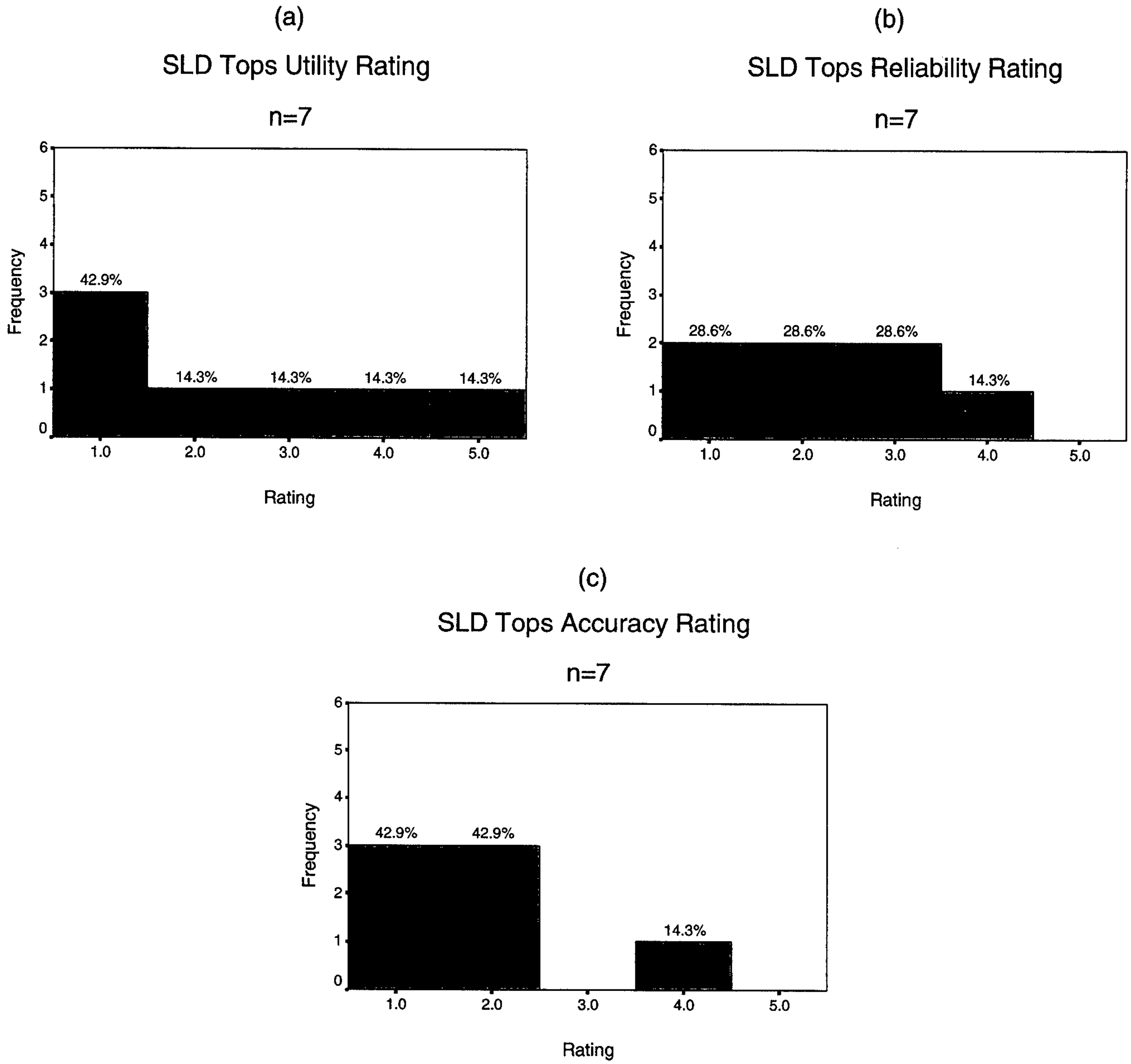


FIGURE 9. SLD TOPS QUESTIONNAIRE RESULTS

5.4.6 Cloud Bases and Tops.

Cloud Bases and Tops were rated separately from each other. Ratings for the Cloud Bases are shown in figure 10. Utility ratings, shown in figure 10a, indicate a wide distribution of ratings with no preferred response. Reliability ratings, shown in figure 10b, have an equivalent distribution with no preferred response. Accuracy ratings, shown in figure 10c, indicate that the majority of respondents were satisfied with the accuracy of the product; however, minor improvements would enhance the product. See figure 3 for a description of the figures.

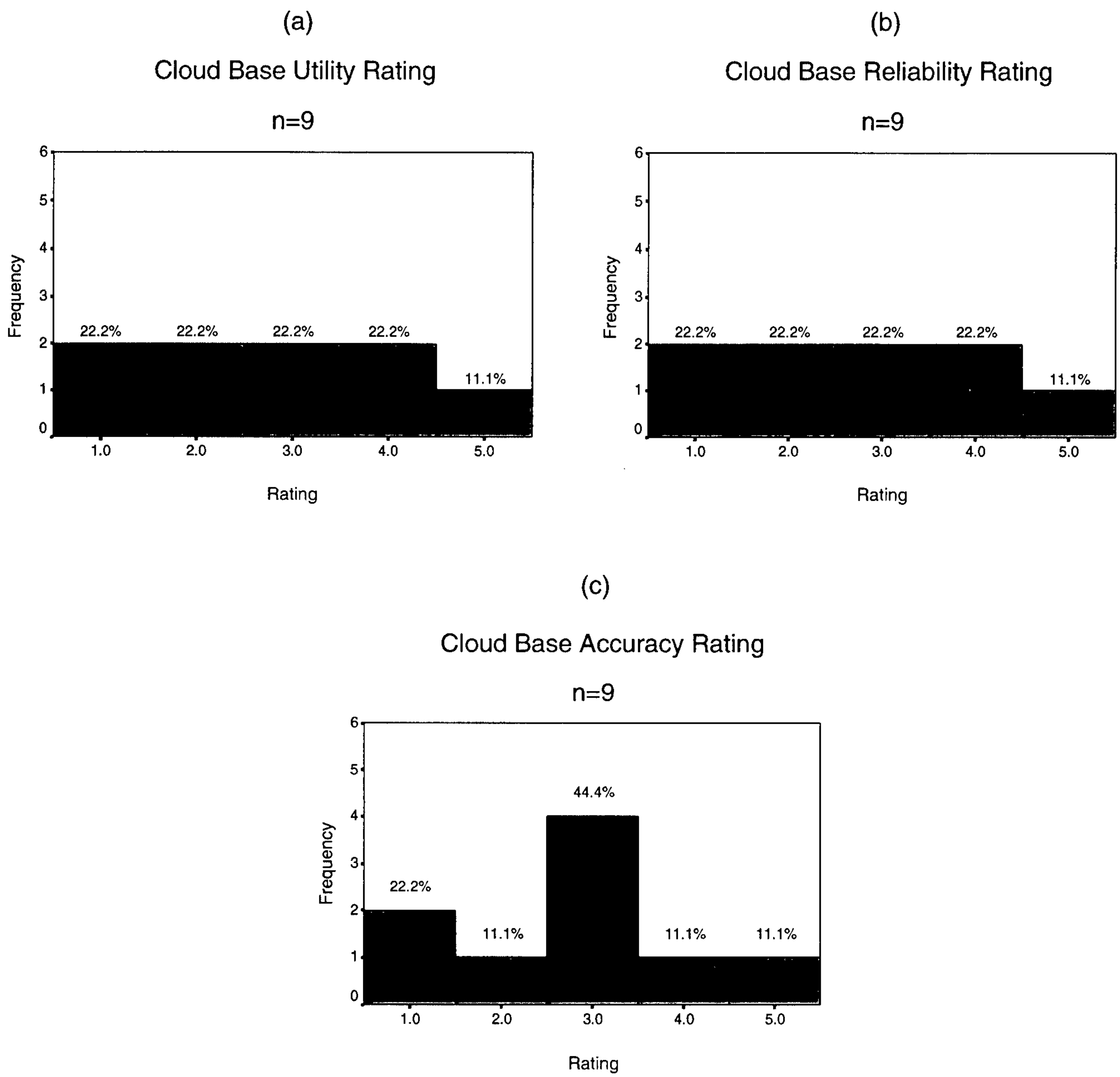


FIGURE 10. CLOUD BASES QUESTIONNAIRE RESULTS

The ratings for Cloud Tops are shown in figure 11. In contrast to the Cloud Bases, the responses to the Cloud Tops exhibit a definite overall positive response. Utility ratings, shown in figure 11a, demonstrate an overall positive response with seven of the nine respondents rating the utility of the Cloud Tops as adequate or higher. Reliability ratings, shown in figure 11b, indicate a tendency for respondents to rate the reliability as adequate or higher. Accuracy ratings, shown in figure 11c, also demonstrate an overall 77 percent positive response rate, with 55 percent of the respondents rating the product as frequently or consistently enhancing their ability to meet the requirements of their job (i.e., ratings of 4 and 5). See figure 3 for a description of the figures.

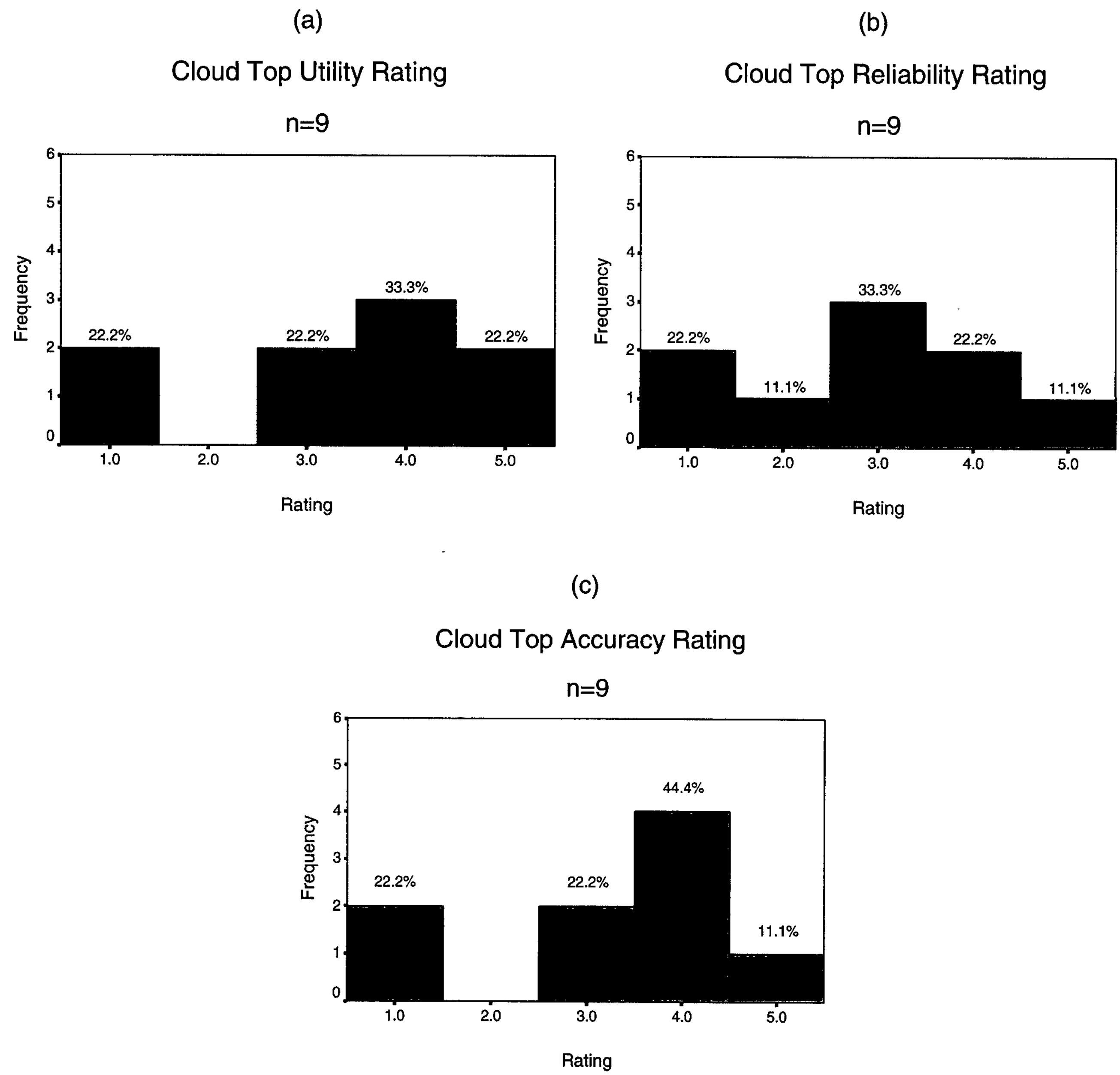


FIGURE 11. CLOUD TOPS QUESTIONNAIRE RESULTS

5.4.7 Product and Component Improvements.

In addition to product and component ratings, forecasters provided comments on potential improvements to the IIDA and its components. Complete comments are listed in appendix E. Potential improvements included:

a. Add icing intensity as an output;
b. Add vertical motion as input;
c. Add atmospheric stability as input;
d. Include models other than the RUC that may have improved relative humidity fields;
e. Remove convectively related icing reports from the display;
f. Include a forecast component out to 12 hours;
g. Smooth the output to remove the "blockiness" of the products;
h. Improve the reliability and availability.

In addition, respondents noted that:

a. Icing Tops in the central US are consistently too high by 4,000 – 6,000 feet -- Icing Tops and Cloud Tops could be very useful if their accuracy is improved;

b. IIDA seemed to have a hard time in low cloud top situations -- could be a result of RUC relative humidity problems;

c. It would be useful to include a symbol at certain grid points, which has the base and top, depicted and that could be overlaid on the Icing Potential or other products.

5.4.8 Added Value of IIDA.

As part of the End-of-Assessment Questionnaire, forecasters were asked to determine if the IIDA provided any added value above existing products. Specific questions and summarized comments are provided below. Complete responses are given in appendix F.

Question: Does the integrated product provide any value beyond having the individual components by themselves? Please explain. Provide examples if necessary.

> Nine respondents answered yes (i.e., integration provides value over individual components), while four respondents answered no (over a 2 to 1 margin). Positive responses indicated that integration is capable of reducing the time in determining an Icing AIRMET. Forecasters noted that there is often little time to devote to forecasts, so integration is helpful as long as the components are accurate. Negative responses indicated that the integrated product was too similar to existing products.

Question: Does the IIDA provide value above what you currently use to create Icing AIRMETs (e.g., satellite, radar, model soundings, PIREPs)? How?

> Most respondents answered that the IIDA did not provide value above current methods (12 no responses, 1 yes response). Responses indicated that IIDA output was too similar to existing products (e.g., icing areas were large), thus it did not provide additional value. In addition, due to the lack of an IIDA forecast component, existing products were reported to be more useful.

Question: Does the IIDA reduce the amount of time necessary to create an Icing AIRMET? How?

> Most respondents answered that IIDA did not reduce the time to create an Icing AIRMET (11 no responses, 2 yes responses). Criticism included the lack of a forecast component, the lack of an intensity measure, and problems with reliability. Even though respondents answered negatively, forecasters did note that if confidence in the output was increased (through longer use or improved accuracy), there was potential for timesavings.

6. CONCLUSIONS.

6.1 ASSESSMENT OBJECTIVES.

Section 4.4 identified the objectives for the Integrated Icing Diagnostic Algorithm (IIDA) Assessment. Individual objectives are restated in the following sections along with conclusions addressing each specific objective.

Objective: Determine if there is value to integrating the various intermediate fields into a single output field.

The assessment results indicated that there was value to integrating fields. Integration was capable of reducing the amount of time needed to prepare icing Airmen's Meteorological Statements (AIRMETs) and Significant Meteorological Statements (SIGMETs). However, in order for the IIDA to accomplish the added value, enhancements such as the inclusion of forecast and intensity fields, need to be included. In addition, Aviation Weather Center (AWC) area forecasters need to have confidence in the integrated output, either through verification results demonstrating superior performance or long-term use.

Objective: What components of the IIDA appear to be providing the most benefit for identifying areas of aircraft icing?

The Icing Potential Product appeared to provide the most benefit. AWC area forecasters ranked the product higher than other IIDA products and components. Interviews and observations confirmed that the Icing Potential was the most useful. The product was especially useful when Pilot Reports (PIREPs) were not available.

The Icing Tops and Cloud Tops were also rated useful as determined from the end-of-assessment questionnaire. Why tops were rated useful and not bases may be related to the use of existing information, such as surface observations, soundings, and measured freezing levels, to identify icing and cloud bases. Forecasters are reasonably confident of these observations. Tops, however, are not included as part of surface observations and there may be less confidence in existing capabilities. Thus, it appears the IIDA Icing and Cloud Tops components may be giving forecasters an enhanced capability.

Objective: What components could be added to improve algorithm performance?

AWC area forecasters recommended the inclusion of vertical motion and stability fields as possible components to improve IIDA performance. In addition, it was recommended that moisture fields from the Eta and Meso-Eta models be considered, since forecasters perceive these fields to be superior to the Rapid Update Cycle model, 60 km version (RUC) moisture fields. However, it should be noted that the recent implementation of the Rapid Update Cycle model, 40 km version (RUC-2) should result in improved moisture fields compared to those with the original RUC.

While not directly related to performance, AWC area forecasters identified the need for forecast and icing intensity components in order to make IIDA beneficial for operational use.

Objective: Under what situations does the IIDA perform well or not perform well?

The IIDA performed well when aircraft icing was the result of very organized, synoptic-scale weather systems. However, many other sources already available to AWC area forecasters (e.g., National Center for Atmospheric Research, Research Applications Program (NCAR/RAP) algorithm) also perform well in this situation. Thus, the IIDA does not appear to be an enhanced capability as far as performance is concerned.

On some instances, there was the identification of IIDA performing better than existing sources when low-level icing occurred. However, several forecasters noted the opposite result, specifically identifying low-level icing situations as instances of when IIDA did not perform well. It was noted that in some of these situations, IIDA identified icing when the cloud tops were 1,000 to 2,000 feet below the freezing level. In addition to the mixed results with low-level icing, an instance with layered clouds was identified as a situation where IIDA did not perform well.

Forecasters noted that additional testing over a longer period of time and during the most intense part of the winter season would be beneficial in further identifying strengths and weaknesses of IIDA.

Objective: Subjectively identify how the IIDA performance compares to current methods used by AWC forecasters for identifying the presence of aircraft icing conditions.

Overall, AWC area forecasters reported that IIDA was no better than existing sources of available icing information. It was noted that IIDA was similar to existing products and did not provide additional information. Area coverage of the IIDA was similar to existing products with the identification of large areas of potential aircraft icing. The exception to this was the Supercooled Large Drop (SLD) Potential, which tended to identify small areas of potential icing. Forecasters perceived the SLD Potential as performing poorly, however, the performance may be a function of AIRMET and SIGMET criteria, which focuses upon large areas of potential icing rather than specific smaller areas.

The performance of the Icing Potential product, measured by comparison to the highest concentration of moderate or greater PIREPs, exhibited positive results with PIREPs corresponding to the higher values of the product. Existing sources of icing information were not compared to the concentrations of moderate or greater PIREPs, thus a direct comparison of product performance is not available. However, based upon forecasters' responses throughout the assessment (e.g., see sections 5.3.2, 5.3.4, and 5.4.8), it appears that IIDA is as good as existing sources of icing information, but not necessarily better.

Objective: Identify AWC data inputs and platforms so that further development can be tailored to AWC operations.

NCAR personnel accomplished this objective during the implementation of IIDA at AWC. ACT-320 personnel did not participate in this activity, thus no information on data inputs and platforms is included in this report.

6.2 OTHER CONCLUSIONS.

In addition to the assessment objectives, other issues identified during the assessment are discussed in the following sections.

6.2.1 SLD Performance.

For this assessment, the SLD Potential product and associated components (i.e., SLD Bases and Tops) did not appear to perform well. Product rankings placed the product and components low in regards to the value in determining Icing AIRMETs and SIGMETs. The performance of the SLD Potential product compared to the highest concentrations of moderate or greater PIREPs indicated that the product did not identify the occurrence of aircraft icing. Overall utility and accuracy ratings were negative. However, it should be noted that in the product rankings (see section 5.2.1), existing sources of information designed to identify SLD related icing (i.e., the Stovepipe Algorithm and surface observations of freezing precipitation) received low rankings in regards to their value in determining AIRMETs and SIGMETs. Thus, the poor overall results of the IIDA SLD Potential product and components may be indicative of a larger issue concerning SLD and the forecasting of hazardous icing situations via AIRMETs and SIGMETs.

The assessment results are not sufficient to provide reasons why the SLD performance may have been poor. Possible reasons include that the product and components are inaccurate; there was a lack of SLD conditions during the assessment period; or adequate training and education has not been conducted in regards to potential icing threats associated with SLD conditions. Poor SLD performance may be due to any of these possible reasons or additional factors that were not identified.

In regards to the SLD Potential performance as measured by PIREPs (see section 5.2.2), it is possible that SLD conditions were not existing in the atmosphere during the assessment phase. Using moderate or greater PIREPs as a measure of performance may not accurately reflect the performance of the product since non-SLD conditions may contribute to moderate or greater PIREPs. In addition, the "poor" performance of the SLD Potential in identifying only small areas of icing potential (e.g., see section 5.3.5) may actually be an accurate portrayal of SLD conditions in the atmosphere.

6.2.2 Bases and Tops.

While no identifiable trend resulted from the assessment results, there appear to be issues with the accuracy of Icing and Cloud Bases and Tops. Some users noted that tops tended to be too high (by 4,000 to 6,000 feet as noted by one forecaster). Conversely, other users noted that the Cloud Tops appeared low and the Icing Bases and Tops both tended to have a low bias. Accuracy ratings for Icing Bases and Tops (described in section 5.4.4) indicate a need for improvement. However, Cloud Bases and Tops received overall positive ratings in regards to accuracy, especially Cloud Tops (see section 5.4.6). Since Icing Tops and Cloud Tops both received high utility ratings, accuracy improvements may provide forecasters an effective source of icing and cloud top information.

6.2.3 Icing Type.

The Icing Type product was perceived by AWC area forecasters as performing poorly. At least three forecasters noted that Icing Type was not applicable or useful. One forecaster commented on being unaware of its existence. If Icing Type continues to be a requirement in AIRMETs and SIGMETs, then improvements in the product must be accomplished.

6.2.4 Display Issues.

While it was not the purpose of the assessment to evaluate display concepts, AWC area forecasters identified several display issues. These issues should be considered if the IIDA or other similar type products are implemented into AWC operations. Issues to be considered include:

a. The blockiness of the output should be smoothed. Note that AIRMETs and SIGMETs are general guidance products, thus the detail provided by the IIDA may not be required for AIRMET and SIGMET generation. However, if finer detailed products are needed, then smoothing of the output may not be desirable.

b. Only Icing Potential output above a certain threshold should be displayed. The display used in the IIDA Assessment displayed all output in the range of 0-100. Thresholding could reduce the apparent overforecasting noted by forecasters, especially since the greatest concentration of moderate or greater PIREPs tended to occur with Icing Potential values of greater than 60.

c. Forecasters favored integration and additional integration should be considered. For example, it was noted that a symbol could be placed on the potential products identifying bases and tops.

d. Removing the display of icing PIREPs due to convective activity, since Icing AIRMETs and SIGMETs are not required for icing resulting from convection.

6.2.5 Reliability.

Many comments were made during the assessment concerning the reliability and availability of IIDA products and components. While round-the-clock availability of IIDA should not have been expected (due to the fact that National Center for Atmospheric Research (NCAR) is not an operational facility with a 24-hour per day support staff), the lack of availability potentially biased several forecasters against IIDA. Consideration should be given in future assessments and evaluations to having algorithms and products running at AWC where availability can be ensured.

6.2.6 AWC Operations.

The results of the IIDA Assessment identified several issues concerning AWC area forecaster operations. These issues should be considered for future assessments of any products, not just icing-related ones.

a. AWC products are heavily influenced by observations. As seen in the IIDA Assessment results, the products that have the most value in determining AIRMETs and SIGMETs are observations. Derived products become more valuable only when observations are not available.

b. AWC is a relatively data rich forecast environment with support staff developing products of their own. Forecasters have a multitude of products to choose from in order to assist in the formation of aviation weather products. Due to the amount of existing products, new products introduced for assessment or evaluation may receive lower ratings than if the product was provided for other operational environments (e.g., Center Weather Service Units (CWSU) and airline meteorology departments).

c. AWC area forecasters have significant experience in the development of aviation weather hazard products. Consequently, forecasters are reluctant to deviate from established procedures and products, which have demonstrated performance levels resulting in forecaster confidence. New products introduced to the forecaster environment must have some demonstrable means of performance in order for forecasters to be willing to review and/or use the products.

7. RECOMMENDATIONS.

The purpose of the Integrated Icing Diagnostic Algorithm (IIDA) Assessment was to evaluate the utility of the IIDA products and components and to provide feedback to the National Center for Atmospheric Research/Research Applications Program (NCAR/RAP) for further development. In light of this purpose, the following recommendations are made:

a. Future emphasis should be on the development of a forecast capability that also incorporates icing intensity.

b. Consideration should be given to incorporating vertical velocity and stability fields into IIDA.

c. Consideration should be given to producing output using the Eta or Meso-Eta models due to the perceived superiority of their moisture fields. However, Rapid Update Cycle model, 40 kilometer (km) version (RUC-2) fields may have alleviated the potential shortcomings in the original Rapid Update Cycle model 60 km version (RUC).

d. NCAR/RAP needs to attempt to identify the reasons for the poor performance of Supercooled Large Drop (SLD) products and components. At a minimum, research results concerning SLD-related icing and meteorological parameters (such as freezing precipitation) need to be provided to operational forecasters through training and education opportunities.

e. Consideration needs to be given to conducting future assessments and evaluations at locations other than Aviation Weather Center (AWC), such as Center Weather Service Units (CWSUs) and commercial airlines.

f. All assessment, demonstration, and evaluation activities must be accompanied by adequate training. Failure to provide adequate training can potentially influence results.

8. ACRONYMS.

ACT-320	FAA Technical Center Weather Branch
AIRMET	Airmens Meteorological Statement
AWC	Aviation Weather Center
CAPPI	Constant Altitude Plan Position Indicator
CWSU	Center Weather Service Unit
EPV	Equivalent Potential Vorticity
FAA	Federal Aviation Administration
GOES	Geostationary Orbiting Environmental Satellite
IIDA	Integrated Icing Diagnostic Algorithm
km	kilometer
mb	millibars
N-AWIPS	Advanced Weather Interactive Processing System for National Centers
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NEXRAD	Next Generation Weather Radar
NIDS	NEXRAD Information Dissemination Service
NNICE	Neural Net Icing Product
NWS	National Weather Service
PC	Personal Computer
PIREP	Pilot Report
RAOB	Rawinsonde Observation
RAP	Research Applications Program
RH	Relative Humidity
RUC	Rapid Update Cycle model, 60 km version
RUC-2	Rapid Update Cycle model, 40 km version
SIGMET	Significant Meteorological Statement
SLD	Supercooled Large Drop
T	temperature
2-D	two-dimensional
3-D	three-dimensional

APPENDIX A

DAILY QUESTIONNAIRE

APPENDIX A
DAILY QUESTIONNAIRE

IIDA Daily Forcaster Log

1. What was the predominant meteorological cause of icing in your area of responsibility?

( ) Synoptic system ( ) Terrain induced ( ) Convection ( ) Other.

2. The IIDA Icing Potential presents a range from 0 - 100. Select the Icing Potential range where the greatest concentration of Moderate or greater icing pireps occurred:

( ) No Pireps available ( ) IIDA did not identify ( ) 0 - 20 ( ) 20 - 40 ( ) 40 - 60 ( ) 60 - 80 ( ) 80 - 100

3. The SLD Potential presents a range from 0 - 100. Select the SLD Potential range where the greatest concentration of Moderate or greater icing pireps occurred:

( ) No Pireps available ( ) IIDA did not identify ( ) 0 - 20 ( ) 20 - 40 ( ) 40 - 60 ( ) 60 - 80 ( ) 80 - 100

Next

IIDA Daily Forcaster Log

What value did products provide in determining your Icing Airmet(s)/Sigmet(s). Rate the following products by selecting the appropriate rating according to your use today in determining your Icing Airmet(s)/Sigmet(s).

1. IIDA Icing Potential
2. IIDA SLD Potential
3. IIDA Icing Type
4. IIDA Icing bases and tops
5. IIDA SLD bases and tops
6. IIDA Cloud bases and tops
7. Graphical Pireps
8. Text Pireps
9. Existing
10. Freezing precip observations
11. Raob soundings

Previous Next

IIDA Daily Forcaster Log

What value did products provide in determining your Icing Airmet(s)/Sigmet(s). Rate the following products by selecting the appropriate rating according to your use today in determining your Icing Airmet(s)/Sigmet(s).

12. Satellite	○	○	○	○	○
13. RADAR reflectivity	○	○	○	○	○
14. CAPI	○	○	○	○	○
15. Model soundings of T and RH	○	○	○	○	○
16. Model soundings of EPV	○	○	○	○	○
17. Neural Net Icing (NNice)	○	○	○	○	○
18. NCAR/RAP Icing	○	○	○	○	○
19. Stovepipe Algorithm	○	○	○	○	○
20. Other: ______	○	○	○	○	○
21. Other: ______	○	○	○	○	○
22. Other: ______	○	○	○	○	○

Clear Product #20 | Clear Product #21 | Clear Product #22

23. Did the IIDA add anything to your knowledge of today's icing situation that could not be readily perceived from products already available: ○ Yes ○ No

Please comment: ______

24. Additional comments (Optional): ______

Previous | Finish

APPENDIX B

END-OF-ASSESSMENT QUESTIONNAIRE

APPENDIX B
END-OF-ASSESSMENT QUESTIONNAIRE

IIDA Questionaire, Page 1 of 3

1. Icing Potential
   - a. Utility
   - b. Reliability
   - c. Accuracy
2. SLD Potential
   - a. Utility
   - b. Reliability
   - c. Accuracy
3. Icing Type
   - a. Utility
   - b. Reliability
   - c. Accuracy

4. List suggestions for improving any of the above products. Please be sure to include the product name in the suggestion(s).

5. List other products that you think should be added to the IIDA.

Next

Rating Scale Definitions

IIDA Questionaire, Page 2 of 3

6. Cloud Base Height
   - a. Utility
   - b. Reliability
   - c. Accuracy

7. Cloud Top Height
   - a. Utility
   - b. Reliability
   - c. Accuracy

8. Icing Bases
   - a. Utility
   - b. Reliability
   - c. Accuracy

9. Icing Tops
   - a. Utility
   - b. Reliability
   - c. Accuracy

10. SLD Bases
   - a. Utility
   - b. Reliability
   - c. Accuracy

Previous | Next | Rating Scale Definitions

IIDA Questionaire, Page 3 of 3

IIDA Components	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
11. SLD Tops						
a. Utility	○	○	○	○	○	○
b. Reliability	○	○	○	○	○	○
c. Accuracy	○	○	○	○	○	○

12. List suggestions for improving any of the components. Please be sure to include the component name in the suggestion(s).

13. Does the integrated product provide any value beyond having the individual components by themselves? ○ Yes ○ No
Please explain. Provide examples if necessary.

14. Does the IIDA provide value above what you currently use to create Icing AIRMETs (e.g., satellite, radar, model soundings, pireps)?
○ Yes ○ No

How?

15. Does the IIDA reduce the amount of time necessary to create an Icing AIRMET? ○ Yes ○ No

How?

Previous | End | Rating Scale Definitions

APPENDIX C

FORECASTER COMMENTS FROM THE DAILY QUESTIONNAIRES

APPENDIX C
FORECASTER COMMENTS FROM THE DAILY QUESTIONNAIRE

Question - Did the IIDA add anything to your knowledge of today's icing situation that could not be readily percieved from products already available?
iida did not show any clouds ovr sern tx where tops were low (around 5,000 ft). it could have been useful in helping to determine the cld tops there.
iida did pretty good job showing areas of icing, but all other diagnostics and algorithms did also.
neb/ks/wrn mo aea of icg had tops arnd 10,000. Hier toped clds fooled iida into putting too high tops in this area. Yet low topped icg 080 srn lwr mi was correctly shown despite thick ci. iida showed low topped icg area over srn lwr mi better than rap/nnice. tops were good in this area
low clds based at 035 tops 060 from ar thru tn/ky. iida correctly showed a narrow column below 060 of low to middle potential icing- that was good. but cloud top algorithm was wacky, showing cld tops to 140
ncar/rap, nnice both showed very large area of icg ovr cntrl plains/mid ms vly where convectively produced clouds were increasing...virtually no icing in that area however.
icing and cloud tops in the ky/tn area were 120-130. iida once again showed too high of tops (160)
iida basicly showed tha same area I! aready had sketched out.
iida generally showed what I aready had sketched out for my icing areas. iida overforecasted icg ovr AZ where there was no clds.
overforecast over UT/CO /MT/WY basicly showing icing in cirrus clouds.
IIDA covered just about the same area I analyzed from other sources in making my icing airmets. I got the same info from other sources. This time it did not have large overforecasted areas where there were nlittle or no clouds.
little value was added and most of the reports were not in the higher potential areas.
large area few reports. clouds over area but tat will not help define area verry well.
fair location for general icing but sld not good.
all pireps of icg lgt to mod or gtr were of rime icg today.
way to low on bases and way to far south.
No icing threat anticipated other than convection. Did mention isolated light to moderate ND?MN based on satellite, neural network and IIDA
satellite imagery, Pireps and Neural Network aided in identifcation of threat areas. IIDA also supported these areas but added nothing that could not have been determined from the above sources.
IIDA broken. It has not updated since 2PM Saturday March 28
IIDA highlighted similar area as Neural Net and NCAR/RAP
Neural Network, satellite imagery and PIREPS identified icing area
Due to N-AWIPS problem, IIDA did not update after 03Z
All icing appeared to be related to convection. Icing Airmet said " No sgfnt ice exp outside cnvtv actvty."
didn't hlep much today. most icing was vcnty pcpn.
Ice was associated with a large scale, slow moving low. There was a high degree of agreement among the various diagnostic tools and among various forecast tools.
Fairly good agreement among diagnostics and forecasts.
NCAR/RAP was out to lunch and IIDA helped to identify that.
Was similar to NNICE and helped in decision making since NCAR/RAP and NNICE differed in coverage in a particular area.

Very Isolated ice reports today mainly in cirrus which is not forecast well by any model. Received only 2 reports which lead me to not issue any airmets for ice. Any other ice expected to be convectively related.
Several light ice reportswith one or two isolated moderate reports in comma head/baroclinic zone from Nebraska to Wisconsin that occurred in area where IIDA indicated no icing. Little or no precip occuring at surface.
Most all reports associated with convection today and very little/no icing where IIDA showed large values
Typical synoptic type system. IIDA underdid tops of icing in Illinois as call from ZKC indicated all aircraft reporting icing between 120 and FL205 between DEC and VLA and tops of icing on IIDA only 140.
Did a good job on depicting low level icing situation over Nebraska and Iowa. Only product I saw which depicted it However overdid icing in other areas.
No iceing reports, although soundings and ncar/rap forecast iceing.
other products showed ice info just as wello.
iida product helped to confirm locations of ice and tops and baseoo
Other products such as NCAR RAP, satellite data and NAWIPS plots of icing reports were sufficient to issue a forecast of icing this morning.
Products such as NCAR/RAP icing, satellite and plots of icing pireps overlayed on satellite image were of greatest value.
No added value over small area of interest in New England.
display a little too noisy. values below 40% should be eliminated
Portions of the iida graphics had missing data.
Missed on two sev and one mod icg report at FL160-FL220

APPENDIX D

FORECASTER INTERVIEW RESPONSES

APPENDIX D
FORECASTER INTERVIEW RESPONSES

The following responses are paraphrased based upon AWC area forecaster responses to the structured interview questions.

QUESTION 1 - Did you use the IIDA for producing Icing AIRMETs/SIGMETs? Please explain why or why not.
Did not add much. Did not really use for SIGMET generation. Already have enough information. I am used to my old ways -what I've used for the past 22 years.
Did not use it at all. Became familiar with it a few days ago.
Looked at it twice. Use Pilot reports. Surface based information gives a better idea of what is going on. I wonder about the accuracy of the product in the West. When you have moisture and movement there's icing.
Not on shift to use it. Looked at it but it was down since Sunday. Still, would probaby not have used it for icing AIRMETs.
Used very little since I am a new FA and getting familiar with other systems. Looked at it for a couple of weeks. Sometimes would look at it before issuance of an AIRMET to verify what was issued. Availability is a problem.
One tool looked at for diagnostics. Already have an idea where icing is and where it is going. I compare to what is really happening. If it looks good I would issue an AIRMET for that area. It confirmed icing at a particular moment.
Used IIDA for AIRMETS, not for SIGMETS. However, used it extensively when it was available on the web site.
Used IIDA around 2/3 of the time. Did not use it for SIGMET generation. Compared to other products, it captured general icing well.
Used IIDA as part of the overall icing process. It was an added component but since it was new and experimental, I did what I usually did. Found it most useful during the midnight shift when there were no pilot reports. It did give an indication of where icing was starting.
I look at it mainly for Icing AIRMETs. It is not the sole source of information, but one source.

QUESTION 2 - How did IIDA information compare to other icing information sources?
Looks at RAOBs first, then heights and types from the ice map (at 0z and 12z). Compare to neural net for percentage of icing in the layers. Use diagnostic products to get the basics. Need to take convective information out for a true report. Also look at CWSU reports - icing up to 30,000 ft. Sensors on aircraft are poor and sometimes not a viable measure. Other products used include: Vertical motion fields - vertical profile potential of vertical motion on the NGM. Neural Net is the preferred icing product. Stovepipe is similar to the IIDA - and was used without much success. Stovepipe is rarely used.
Seems similar to the Stovepipe product. It looked better than Stovepipe but I don't use Stovepipe. I need a forecast -this is only a detection product. Mostly use PIREPS, the RAP product or Neural Net. Disappointed with RUC - it doesn't go out far enough. Prefer NGM and Meso Eta models.
Did not compare - seemed useless - no forecast in it. I like RUC II and the Meso Eta model over 4 panels. There's too much information on the RUC II model. Looks at 50% and higher levels on RUC II (blue areas) Then all bases, then bases and tops. Works well for all sections of the country. For SIGMETS, mainly use Pireps, surface reports, visibility and intensity.
No better than NCAR/RAP (a little better).
IIDA missed icing above 16,000 ft. due to the mountains. Use the Meso ETA model where 90% relative humidity and temperatures were bordering at the higher edge of the icing spectrum. Also use vertical motion.
Good diagnostic tool like Neural Net - most icing appears where it's red. Icing bases and tops are not useful. Uses the Meso Eta 4 times a day. However, questions the viability of the RUC 2. Finds that the PROF. ICG product which includes temperature, RH, and forecast soundings (EPV) is good.
Looked a lot like several broadbrush products, i.e.: RH and thickness and the NCAR/RAP product seemed to have similar output.
Compared IIDA with ETA, Meso ETA, Neural Net, and RUC. General icing seemed OK - bases and tops were good and pretty accurate. Other products showed much the same. Colors were hard to interpret and needed to be smoothed out. The number of colors was adequate but contouring also needs to be smoothed. It did well with layered clouds. Coverage was good, but sometimes overdone.
Liked the overlaid PIREPs but found them difficult to read. Didn't compare to other sources. Found it simpler to use than profiler information. Found it somewhat reliable and began to develop trust in it. May use IIDA output for AIRMETs but probably not for SIGMETs.
The display is too busy. The colors are overwhelming. The thresholds need to be established. Its okay if PIREPs fall outside of an area. Colors need to be changed to pick out the PIREPSs. Probably the last source used for issuing AIRMETs. Prefers other sources and the ability to window four displays at once.

QUESTION 3 - What components, if any, did you find most useful? Why?
SLD was not useful. Tops and bases were most helpful. Likes the display but is unsure of how to interpret it.
Icing intensity may be most useful. Icing type could be useful.
Wasn't worth the time - didn't look at it. Terrain is most important.
SLD is the worst component. SLD does not get to what you want. Freezing rain is not as important. Use for product currently: 1) define process, and 2) run and use the process.
Clouds tops and bases, and icing layers (potential). Did not use SLD, especially for the Western region.
Icing potential was the only component really used. Icing bases and tops were not used much. Was not comfortable using the SLD component. Would probably use and look at the IIDA more throughout the winter. Does not know if "Icing Type" is needed or not.
Icing tops were less useful than expected. IIDA reported very high tops, i.e. cloud tops at 12,000 ft. were reported at 16,000 ft. Although cloud heights were well established, IIDA would typically report them at 4-6 thousand ft. too high. Cloud bases, however, were good.
Looked at icing bases and tops more than clouds. Icing bases and tops did a good job. SLD bases and tops were not useful. Icing probability was used the most and found to be most useful. Did not use icing type and didn't know it was available.
Icing potential and icing layers were most useful. Sometimes bases and tops information was useful. Icing type had some merit. Components not needed include: Clouds information; SLD (which gives some good information but to a limited extent) SLD information, however, is probably underutilized. There's not enough time to include this information in an AIRMET.
Mostly used Icing potential. Received good ideas on tops from PIREPs and got a handle on where icing would be. Freezing levels are obtained from surface charts and satellite imagary. Likes to see a general pattern of icing potential and then uses models to see how this will change.

QUESTION 4 - Describe typical situations, if any, where the algorithm and/or its components performed well.
Yes, there were a couple of instances where the product performed well - appeared to match some of the other output.
No comment.
For other FA positions it possibly could be useful.
Icing potential performs better. Clouds information is the foundation in combination with observation and and satellite data.
Liked the graphical display.
IIDA is as good as CAPI if icing levels are in the moderate to high range. Worked best with deep area moisture around a low pressure area (like other models). Would identify a well organized system.
"Told me what I already knew". Icing potential could show how icing is trending, however, this information is redundant. It would be helpful if it were compared to the NCAR/RAP product to see where ice is detected and then forecast it out.
Can't recall when it out- performed any other information source. Probably as good as anything.
In large scale synoptic situations that were well organized.
Well defined synoptic situation. Covers everything - almost too much. Doesn't add anything to what is already available. However, the product does provide the initial pattern.

QUESTION 5 - Describe typical situations, if any, where the algorithm and/or its components performed poorly.
Icing type and SLD don't seem to correlate.
No comment.
In the West there were no SLD areas. Does not meet AIRMET criteria.
SLD performed poorly. Not a good conceptual model. All significant icing develops in range of SLDs - limited to processes - other processes not emphasized enough. Need to look at whole process of how icing forms. Better algorithms emphasize what we know and what the atmosphere is saying . When you relate the algorithm to the PIREPs, IIDA misses the mark. The foundation though is necessary. We need to develop a better algorithm on top. Different output would be preferable. Trying to show SLD and icing potential obscures the PIREPs. Icing type is totally unnecessary and can be eliminated. 4 panel plot is not the best display. Colors are OK however. Avoid long down times.
Moderate reports missed big when compared to PIREPs. The display was too noisy. High icing potential (red) was indicated at certain altitudes, but there was no verification. Product was " overdoing" detection. In Montana and Idaho, there was a problem at low altitude - the product was underforecasting. IIDA is very time consuming to use. Reliability is a problem.
Colors were not significant except for red. Everything else is inconsequential (on icing potential). Did not always work well especially when there was lower icing under 10,000 ft. - over 10,000 feet it did a good job like the models. ETA, NGM, and Meso ETA worked best for low level icing. Tops information is inadequate. There are better things to look at. However, when looked at, there was not much icing around. Very skeptical of the SLD component.
Already describes the NCAR/RAP and RH + temp output. Needs a differentiation of severity. The category and severity of icing needs to be known. IIDA did not add anything. It paints large areas that were already identified. Not filtering down enough - areas are too large. i.e., high icing potential covered a very big area. However, it missed the freezing level on low topped cloud decks, sometimes by 1000 feet - this is critical. The top of the cloud deck is the most likely location for icing. The SLD component cuts the area down a great deal, but doesn't relate to anything. Need to test IIDA in the winter.
Once IIDA totally missed significant icing. The area was blatantly apparent - a synoptic stable system in the Pacific North West. There was lots of ice, but the algorithm missed it.
Sometimes there were software glitches and sometimes the product did not update.
Sometimes icing PIREPs fell outside of a detected area - even when the coverage was extensive. There was some doubt in these situations. Its nice to see where PIREPs are falling in relation to everything else.

QUESTION 6 - Miscellaneous Responses
No Comment.
Needs forecast up to 18 hours for outlook.
No comment.
Threshold would be good, I.e.: icing below 50,000 ft for icing potential. Calibration numbers are questionable. Concentrate on intensity and then lead the way in how icing is forecast.
Would like a layer forecast for thicker layers. Getting through different levels is time consuming. Adding vertical motion would be helpful. Added forecast potential would compliment what is already used. The forecast does not need to go beyond 12 hours. Could be used for SIGMETs.
Wants to keep all of the IIDA components so that everyone can choose individually. Everyone has different needs. Enhancements: Cut off temperature at -25c (which is the AWC cut- off). Could be cause of discrepancies. Also clouds looked lower than they actually were. Bases were OK for freezing level, but there were discrepancies with tops. A forecast is needed since 90% of time you need to be looking out. It would be good if it could forecast out to 12 hours. The Neural Net product forecasts out as far as the models. If a forecast is reliable, it will be compared to the Neural Net and the best one wins. However, lateness of season for this product provided an unfair test.
A forecast would be an improvement, but by definition you can't get a forecast with observations, satellite and radar. The following are not needed: Icing type - No better than what we do., SLD - not much use, however there may be some marginal use in colder weather. A better way is needed of showing multiple layers of cloud tops. Perhaps looping the clouds to see multiple layers would give unique information. Could also use a better display of clouds.
May use IIDA if its here and improvements are made. Could be a useful diagnostic tool to use with other weather sources. SLD "goodness" is questionable (like the Stovepipe product.) Integration of the products on IIDA may have saved some time (questionable) but in a situation when there is no time to look at all models and soundings, it wouldn't be used. Could be useful for comparisons.
IIDA Would be a worthwhile tool overall, added to everything else.
Time savings? Yes as far as the pattern it shows. Reliability was not good. Sometimes the product was down and you never knew when it would be available.

APPENDIX E

PRODUCT IMPROVEMENTS IDENTIFIED FROM THE END-OF-ASSESSMENT QUESTIONNAIRE

APPENDIX E
PRODUCT IMPROVEMENTS IDENTIFIED FROM THE END-OF-ASSESSMENT QUESTIONNAIRE

Question – List suggestions for improving any of the products (Icing Potential, SLD Potential, Icing Type). Please be sure to include the product name in the suggestion(s).
icg potential needs to be related to intensity. since we only issue airmets for icing that is expected to be at least occasionally moderate or greater, the iida's depiction of a near certainty of what will surely be light icing has little utility.
Vertical motion fields need to be included such as 72v. I have found when mod to stg subsidence or mod to stg upward motions are occurring then the amount of icing is lessened. The map value of + or - 3 seem to be the outside limits many reports.
Try to make IIDA more reliable. There were large blocks of time over the weekends when IIDA was unavailable. Try to incorporate satellite imagery within the IIDA algorithm. There were time when IIDA depicted icing where there were no clouds.
there were too many times when all of the data was not avialable.
Did not see much difference between this and other products. Also it seemed to have a hard time in low cloud top situations handling mid level clouds. i think this is result of the RUC model which has RH problems.
We need forecasting, not hindcasting aids.
General icing and SLD categories do not "hit" the target which is icing intensity. General icing was too much of a temp/RH cloud diagnostic. SLD does not give clues to higher intensity icing so has no real skill. Icing type also has no skill.
icg potential product was pretty good in locating general icg areas but overforecasted areas at times. smoothing contours would help in analyzing product. sld potential product has little utility. saw no pireps to indct sld icg.
Perhaps some smoothing technique could be used to eliminate the extreme blotchiness of the icing potential.
More often than not, the product was too old to use or simply unavailable. As far as the accuracy of the icing potential, the product I had the most amount of time to use, it did not verify very well in the Western US. Needs fewer layers at this point.

Question – List other products that you think should be added to IIDA.
Icing intensity
The products available are adequate.
this questionaire will only let you comment with a limited number of characters, even though there is still plenty of room left in the text box!
stability/vertical motion
Air Force Iceing analysis on realtime RAOBS.
I'd like to see the IIDA run on some other models which have better RH forecasts to see if it has more utility.
need an algorithm to project and forecast icg for the next 6-8 hrs or so.

Question – List suggestions for improving any of the components. Please be sure to include the component name in the suggestion(s).
icg tops in the centeral ptn of the US are consistantly too high by 4-6,000 ft. icg tops and cloud tops could be the two most useful outputs from the iida, but the accuracy has been poor. SLD hasn't seemed to relate to ice type or intensity.
Remove ice reports from the data base near thunderstorms. Determine type of aircraft and use to define intensity by aircraft type.
Have forecast fields out to 12 hours for all of the components
It's probably my fault, but I did not know what "Icing Cloud Hgts and Bases " means.
Already listed several suggestions in previous answers
Add a forecast capability, possibly based on TAF's or model data.
Base and top thresholds too low.
Do not see need for 10 percent intervals--makes appearance too blotchy.
A composite layer product for icing potential with the ability to look at smaller layers when necessary. Or a symbol at certain grid points which has the top and base depicted, and the ability to overlay this on top of the icing potential/other product.

APPENDIX F

IIDA ADDED VALUE IDENTIFIED FROM THE END-OF-ASSESSMENT QUESTIONNAIRE

APPENDIX F
IIDA ADDED VALUE IDENTIFIED FROM THE END-OF-ASSESSMENT QUESTIONNAIRE

Question – Does the integrated product provide any value beyond having the individual components by themselves? Please explain. Provide examples if necessary.
in theory, it should be best to integrate the base/tops/cloud and model info into one product to provide a one-stop look at the icing layer. the accuracy has been disappointing, though.
It is similar to the NCAR RAP and neural network icing in depicting a threat area.
In the winter there is often little time to devote to the Icing forecasts. Graphics that summarize or otherwise depict data from several fields are appreciated.
Not much additional information here than from other products.
Reduces number of seperate screens to look at.
Integrated product is better than the individual components. The individual components could be better which would improve the integrated product.
can save time in determining icg airmet. but this also may reduce the accuracy somewhat.
Because of time factor, we are often unable to look at so many components in preparing airmets/sigmets.
A lot faster to use.

Question – Does the IIDA provide any value above what you currently use to create Icing AIRMETs (e.g., satellite, raar, model soundings, PIREPs)? How?
it basically draws the same large area that we get from other "cold cloud" forecasting tools
icemap and other current products are as good or better.
It does not add any information to tools and algorithms already available to the AWC
It helps some, but not a great deal.
I do not much additional value to what other products are currently available.
It has no forecast function.
AWC icing tools are more advanced than IIDA.
To be honest, I found little value over the tools we already have. When forecast tools are available from other data sources, these prove to be much more useful in my view.
It seems to reflect what we can gather from other sources...ie it's nothing new and improved or above and beyond the rest of the tools we use, though I did like the graphics display.

Question – Does the IIDA reduce the amount of time necessary to create an Icing AIRMET? How?
no, because it is not related to intensity
pireps during the day are the biggest help.
It does not add any information to tools and algorithms already available to the AWC
Since it is only a diagostice, it lenthens the process of formulating and AIRMET. It had too, it is another tool to look at. It didnot take the place of anything else.
Product not timely many times and out of date when producing airmets. Greater timeliness would be first large step in a producing an additional in-depth evaluation in the future.
It provides a minimal amount of information, but takes too much time to use.
I still need to look at other tools,
it does reduce the time..but i do not have complete confidence to rely on it totally. i still prefer to look at satellite, radar, model soundings and pireps and also the previous history of where the icg has been ovr the past several hours.
As with any new product/technology, a longer period of evaluation or actual use would be necessary to determine if time could be saved using this product.
icing rules!
If the product displayed the data with information overlays, it could be faster, but with the misses it has on accuracy, one would spend more time checking to see if it is believable. It has potential, (no pun intended) but not quite there yet